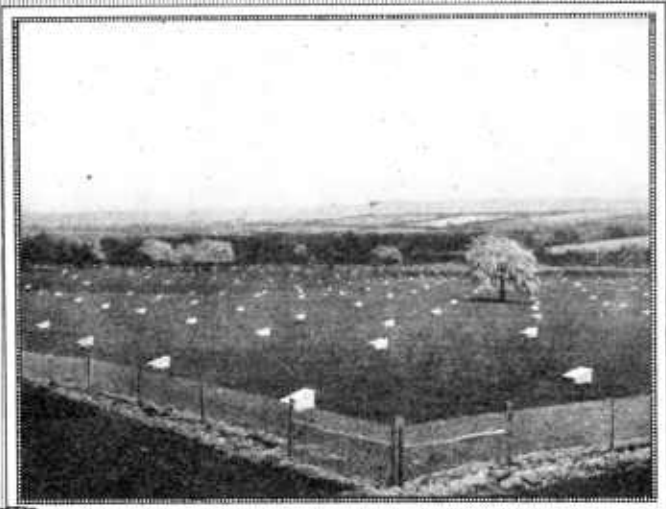


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U. S. DEPARTMENT OF
AGRICULTURE
FARMERS' BULLETIN No. 1521

PROPAGATION



SUCCESS in the propagation of game birds has been enjoyed in the United States by individuals, by sportsmen's organizations, and by State game departments. There have been failures, of course, but methods that assure success are known. These are treated concisely in this bulletin and are elaborated upon in other publications, a list of which may be obtained by application to the Biological Survey. Developed methods need only be carried out with energy and intelligence to produce satisfactory results. Raising game birds may be made profitable, since the demand exceeds the supply of adult birds for breeding, of both young and adults for restocking, and of eggs for distribution to farmers and shooting clubs. *The United States Department of Agriculture does not have game birds or their eggs for distribution.*

PROPAGATION OF GAME BIRDS

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INTRODUCTION

WITH INCREASE in population in the United States, the number of hunters has grown enormously, and with progressive settlement areas naturally productive of game birds have been greatly restricted. Propagation is necessary, therefore, if the national supply of game is to be maintained. The possibilities of game-bird propagation have long been demonstrated abroad, where on numerous estates large stocks have been produced year after year by hand rearing. Enough has been accomplished in the United States to prove that increase in the extent of successful game farming is limited only by the area, expenditure, and effort devoted to it.

This bulletin applies primarily to the ring-necked pheasant, the bobwhite quail, the mallard duck, and the Canada goose, species with which most success has been achieved on American game farms, and secondarily to a number of other game birds that have been reared less extensively, and for which more or less tentative directions for handling are reported from the methods used by the most successful breeders.

GENERAL REQUIREMENTS

LICENSES

Most States have laws or regulations affecting the propagation of game birds, and many require game breeders to take out licenses. In addition, Federal permits are necessary for lawful possession of wild ducks, wild geese, and other migratory game birds in captivity. Federal permits are obtainable through the Biological Survey,

United States Department of Agriculture, Washington, D. C., as also are copies of digests of State laws on game-bird propagation, and the addresses of officials to whom application should be made for State licenses, and for the full text of State laws relating to the propagation of game birds.

SITE

AREA REQUIRED

Small numbers of game birds can be reared with more or less extemporized equipment moved about within the confines of a roomy dooryard or in a small orchard. Game-bird propagation on a sustaining and business basis, however, requires plenty of room. For reasons to be explained under the heading "Crop rotation," the area of land available should not be less than four times that required to care for the birds properly for a single year. Plenty of space is needed for the further reason that in most cases it is desirable to produce birds that will be as wild and wary as possible. These qualities improve the chances of planted birds escaping natural enemies and can be achieved to the maximum only on grounds where the birds can roam with the least restraint.

SOIL FERTILITY

To be successful, the propagation of game birds must be on a crop basis. On the efficient and economical game farm as much as possible of the seeds, grain, and forage consumed by the birds must be produced on the ground. Insects, so necessary an element in the food of the young, must be wholly of local origin. This vital food supply, which more than any other factor decides the success or failure of game-bird production, depends almost directly upon soil fertility, for insects can subsist in abundance only upon rank vegetation.

No land is too good for a game farm. Those who hope to succeed on tracts useless for other purposes, on barren areas where almost every particle of food consumed by the birds must be brought in and hand fed, are doomed to disappointment. In such places the vitalizing elements are lacking, and it will be impossible to produce there the healthy, vigorous stock necessary for continuous maintenance of a game farm.

CROP ROTATION

Soil fertility is not only an initial requirement for the successful game farm; it must also be maintained. In fact, the purely agricultural phases of the game farm must be managed with just as much foresight and care, and in much the same way, as a hay or grain farm that is kept on a profit-yielding basis. Proper cultivation of the soil is important, not only in preserving the basis of production but also in rejuvenating the land after the fouling that is unavoidable when large numbers of birds have been kept on it for some time.

Plowing, fallowing, fertilizing, planting, and cultivating are as essential to the upkeep of the farm upon which game birds are the crop as on any other. To rest and renovate fields upon which a crop of birds has been reared it is advisable to follow with little

change the scheme of crop rotation that has been found satisfactory in the region concerned.¹ The special object of crop rotation on the game farm is to end it with a mixed growth of hay-producing plants as lush, luxuriant, and healthy as it is possible to produce. In such an environment breeding stock can be kept vigorous and productive, and young birds can be reared quickly and with the smallest losses. Cultivate as smoothly as possible so as to give many nearly level spots on which coops can later be placed.

As a sample of rotation methods, those in use on the New York State game farm, at Sherburne, may be cited. In the short or two-year rotation the land is broken, cultivated, and planted to corn immediately after its use, either as a breeding or rearing field, in spring. When the corn is taken off in fall a mixture of timothy, clover, and redtop seed is sown, and the field is used for birds again the next year. In the long rotation oats or wheat follow the corn, extending the round one year.

SANITATION

Birds are unable to tell of their discomfort, and often no difference in appearance or behavior can be noted before one is sick unto death. Treatment then is generally ineffectual. From every point of view the watchword should be "prevention." One cardinal rule for the game farm is to keep the living quarters of the indispensable poultry always entirely separated from those of the game birds. Domestic fowls have diseases to which they are more or less resistant but which will sweep through a flock of game birds like wild fire. It is well even for the sake of the poultry to change their quarters occasionally and to renovate the land; but under no circumstances should ground fouled by poultry be used for game birds until it has been baked by the summer sun, frozen by the winter cold, and plowed, fallowed, planted, and renovated to the last degree of thoroughness.

The prevention of disease depends to a great extent also on the policy followed in respect to the introduction of new stock on the game farm. On a going farm it pays to let well enough alone. The acquisition of fresh stock to cure fancied ills of inbreeding is fraught with such danger that it should not be undertaken except when the need is unmistakable. The fertile, well-managed game farm will have vigorous healthy stock, and once having it, the owner need give no consideration to the bugaboo of inbreeding. In fact when the stock is sound, the closest sort of inbreeding results in steady improvement. When for some important reason it has been decided to bring in new birds, they should be held for observation for some time before they are allowed to mix with the regular stock. For this quarantining roomy and sanitary inclosures should be provided, since crowded quarters in themselves tend to promote disease.

VERMIN CONTROL

After disease, feathered and furred flesh eaters, popularly called "vermin," are the worst obstacles to success that the game farmer has to overcome. Among birds, the Cooper hawk is probably the

¹ Information on crop rotation and publications on the care of the crops recommended may be had from the Bureau of Plant Industry, United States Department of Agriculture.

worst pest on game farms, with the sharp-shinned hawk, great horned owl, and crow scarcely less important. Sometimes other hawks, as the red-tailed and the red-shouldered, are tempted by the plentiful supply of food offered by a well-stocked game farm; but, as these hawks are habitual mousers, warfare against them should be upon individuals proved to be rogues and not upon the race. Even the ordinarily beneficial little sparrow hawk at times can not resist an easy chance to pick up young pheasants. Owls other than the great horned owl are occasional marauders, and even crow blackbirds (grackles), red-headed woodpeckers, and blue jays sometimes become destructive to pheasant chicks.

Among mammals the most dangerous enemies of birds on game farms are cats, free-roving dogs, rats, and weasels; of lesser importance are minks, foxes, badgers, skunks, opossums, and raccoons. Even the little ground squirrels, or picket-pins of the prairie States, eat the very small young of game birds. Snakes sometimes figure prominently as egg thieves; and bullfrogs, snapping turtles, and such fish as pike, pickerel, and bass, if allowed to live in a duck pond, will seize and devour a great many ducklings and even attack adult birds.

These various animal pests find a center of attraction in game farms, and the necessity for their control in such places is freely admitted. Efforts along this line, however, are apt to vary widely. Some are well considered, selective, just, and sensible; others are blundering, indiscriminate, unnecessarily cruel, and fanatical.

FENCING

Usually the main dependence for vermin control is appropriate fencing. The entire farm may be surrounded by a permanent vermin-proof fence; or the rearing or breeding fields may be guarded either by semipermanent fences, or even by temporary and easily movable fences that will exclude most vermin; or all such fencing may be dispensed with and only the bird pens themselves used to give protection. The pens are usually built so as to keep out both ground and winged enemies.

PERMANENT FENCE

Fencing of a type deserving to be called permanent is expensive—prohibitively so in most cases where profits are an object. Suggestions, however, as to the construction of such a fence may be in some demand, and hence are given here. The permanent fence should have concrete posts and a foundation of equal thickness, the latter extending about a foot both above and below ground, and into the upper part of it the woven wire should be embedded. All mesh should be of the type galvanized after weaving. The lower course of 30 to 36 inches should be of $\frac{1}{2}$ -inch or $\frac{3}{4}$ -inch mesh and should have extending outward from its upper margin an overhang 1 foot wide of the same mesh. The upper part of the fence should be of not more than 2-inch mesh, and the top of it supported by a tightly strung barbed wire. Several other closely spaced strands of barbed wire or another overhang should form the top of the fence. The total height, excluding overhang, should be at least 8 feet. Modifications that may be made in this fence that will not seriously affect its

permanency are the use of creosoted poles for all but corner and gate posts, and creosoted cypress (pecky for economy) planks, 1 by 6 inches, instead of the concrete base.

SEMIPERMANENT FENCE

The ordinary semipermanent fence (fig. 1) ² generally used where that type of fencing is desired, departs from the ideal in several respects. However, wire galvanized after weaving is preferably used. The posts are all wood, creosoted at the base if possible; the mesh of the lower course is 1 inch, and about 6 inches of this strip is buried in the ground. The overhang if placed at the top of this strip is of the same mesh, for it is wasteful to use for an overhang mesh smaller than that which it surmounts, because small climbing vermin will go through the first openings they find large enough.

The upper course of the ordinary fence is of the familiar poultry netting (2-inch mesh), and the overhang (1 to 3 feet wide) at the top is of the same material. The height should be 8 feet but sometimes is only 7. It is well to have a supporting strand of barbed wire along the top to keep the fence in better shape and especially to resist the weight put on the netting by sleet storms. It may be necessary also to reinforce a netting fence with barbed wire strung where horses, cattle, or hogs may come in contact with it.

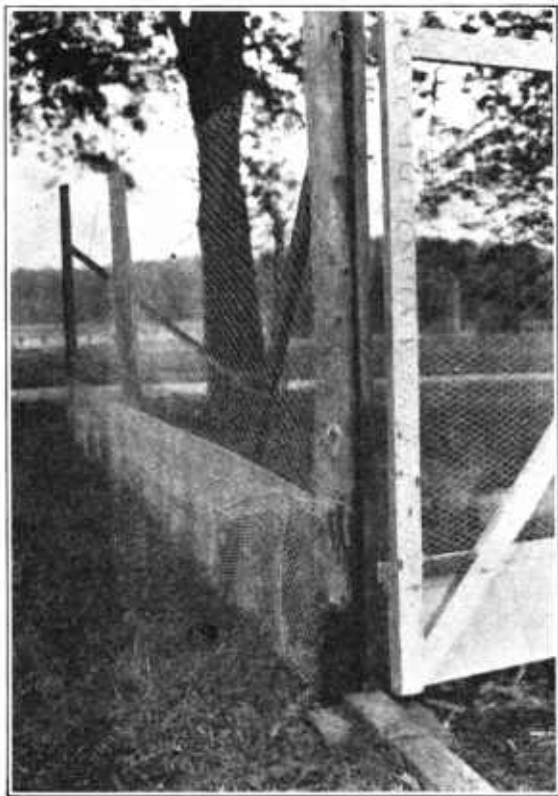


FIG. 1.—Semipermanent vermin-repelling fence

TEMPORARY FENCE

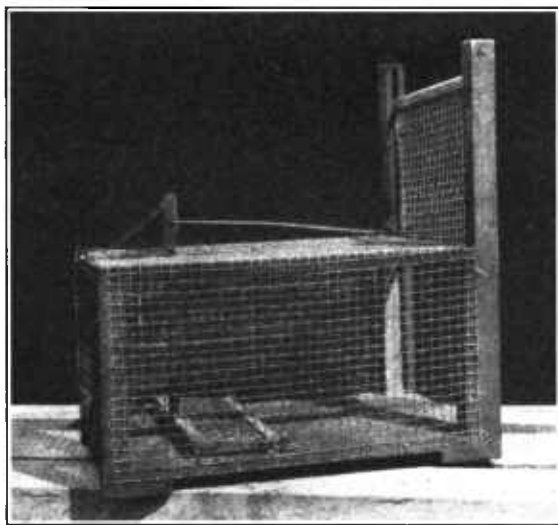
Where the vermin problem is not serious or where general activity against vermin keeps it under such control as not to involve too

² Of illustrations in this bulletin the title-page photograph was supplied by the Conservation Commission of New Jersey. Figure 17 by Samuel C. Evans, Figure 18 by D. H. Beyea, and Figure 27 by the Conservation Commission of New York.

great risks, temporary or portable fencing is used to advantage. The supports for such fences are light poles put in holes made with a crowbar. The lower course (3 feet) of the fence is of 1-inch mesh (sometimes closer when it can be afforded) that has a single furrow turned over its base. The upper part (6 feet) is poultry wire without overhang. The two strips of mesh are pinned together with nails. This fence can be quickly and easily moved from one field to another, and on account of the frequent rolling and general wear and tear that it undergoes, for economy it is usually made of wire galvanized before weaving.

TRAPPING³

Theoretically, a vermin-proof fence should make trapping unnecessary. Unfortunately such fences rarely are entirely vermin-proof,



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FIG. 2.—Evans vermin trap. This trap is 14 inches high, 17 inches wide, and 24 inches long. The front standards are 27 inches tall and contain a slot three-eighths of an inch wide and five-eighths of an inch deep. The door measures 15 by 12 inches. Door and treadle (6 inches wide) have the edges soldered in folded strips of heavy zinc. Mesh is five-eighths of an inch square heavily galvanized. All screws are brass, the spring phosphor-bronze, and the levers iron. The corner posts are tinned inside and the whole trap dipped in paint. The small triangle of tin on the far standard falls across the slot when the door is down and prevents it from being raised.

and, if so at first, seldom retain perfect effectiveness. Vermin having once entered the game farm or subsidiary inclosure, it is necessary to combat it directly, and trapping is a favorite method. Traps are indispensable aids in controlling vermin, but their use is often turned to abuse. Care should be taken as to where and when they are set, and as to how long they remain set. A set trap is dangerous 24 hours a day every day, and will catch other creatures just as effectively as those particularly sought. It should not be placed, therefore, where it will be a menace to other than the offending

animals. It should not remain set after danger from vermin has passed. While set it should be inspected at least once daily so as to shorten the period of the captive's sufferings, and to release an

³The limits of this bulletin prevent giving specific instructions for trapping various kinds of animals. These may be found in general works on the subject of trapping, a list of which may be had upon application to the Biological Survey, United States Department of Agriculture. State laws relating to the protection of fur-bearing animals, many of which are on the game breeders' list of vermin, are digested in a Farmers' Bulletin that can be obtained from the United States Department of Agriculture. In many States trapping protected animals is allowed owners in protecting their property.

innocent creature alive. This last consideration makes traps that catch their victims alive and uninjured far preferable to traps that kill or that cripple when they do not kill.

TRAPS FOR GROUND VERMIN

The Evans vermin trap illustrated in Figures 2 to 4 is ideal for ground vermin, since it can be built any desired size, and makes the capture without injury. Probably the best way of disposing of destructive animals caught in this trap is shooting them with a small-caliber pistol, which can be carried in a pocket without inconvenience. Snakes, toads, frogs, rabbits, and other harmless animals caught in this trap can be released alive if inspections are made daily, as they should be. A decided advantage of this trap is that stray game birds will get into it and can be restored to stock.

The Evans trap is very effective when set with the side close against a fence (fig. 4). Sometimes a stake is placed against the door frame of the trap to hold the trap firmly against the fence and to support a short wing of wire netting flaring off to another stake to direct into the trap animals that might otherwise pass a few feet away. Sometimes the trap is set with the mouth against an opening in the fence, and so hooded over with wire netting that entrance into the trap is the only possible course. Ordinarily no bait is required, but should its use become desirable it can be wired to the back wall of the trap.

In certain cases it is necessary to vary the method of trapping, and then ordinary steel traps can be used. These are probably the best devices for use against rats⁴ under buildings and other structures. Great care must be taken, however, to set these traps where game birds can not get into them. In burrows under objects and in holes where the birds can not go the trap may be set without special protection. Elsewhere it may be put under a box with a notch cut in the edge, under a troughlike shelter made of three boards, or under a cover improvised from wire netting, in each case, however, with the entrance to the trap so small that the birds can not get in. All such sets are best made along fences where ground vermin are prone to run. Ground traps of all kinds should be kept out of rearing fields where there are small game birds.

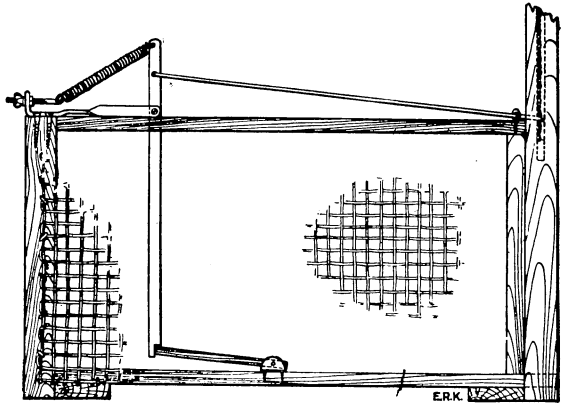


FIG. 3.—Operating parts of Evans vermin trap

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⁴ Full information on the control of rats is contained in Farmers' Bulletin 1302, How to Get Rid of Rats.

TRAPS FOR BIRDS OF PREY

Winged vermin also have been combated chiefly by use of traps. The most common device is an ordinary steel or jump trap set on the flat top of a post or pole and fastened to it by the chain of the trap. These traps instantly kill small birds getting into them and usually are the cause of lingering death to larger species, which in their struggles fall with the trap from the top of the pole and hang head down until death ensues. Birds that do retain their perch on the top of the pole usually have one or both legs injured so that it is necessary to kill them. These troubles can be obviated in part by having the chain of the trap attached to a large ring around the pole that will slide to the ground when the trap is moved from the top. This permits the release alive of any useful bird that has not been crippled by the first grip of the trap.



FIG. 4.—Evans vermin trap set along fence

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As ordinarily used pole traps are objectionable in several respects. Not only should the number be reduced to the minimum but also the objectionable features of those kept in use should be lessened. Breaking the legs of larger birds can be prevented by wrapping the jaws of the trap near the ends with hard cord of sufficient diameter to keep the jaws well apart when sprung. This will hold the larger birds but will permit the escape of such smaller ones as are not disabled or killed when struck by the jaws of the trap.

The indiscriminate killing of various small birds is the greatest fault of pole traps. If the traps are kept set at all times, 10 smaller birds will be killed to every hawk captured. It is a painful experience to make the rounds of a game farm and find flickers, red-headed woodpeckers, kingbirds, and bluebirds dead in the pole traps. Such destruction of innocent birds not only constitutes unnecessary cruelty but is also wasteful of these useful bird lives and in most cases is a

violation of Federal or State law. The killing of small birds by pole traps can be obviated, in part, by setting traps too heavy for such birds to spring them. Both legal and humanitarian considerations require that the use of pole traps be carefully regulated. If moderation in using them is not observed, legislation entirely forbidding their use may be expected.⁵

Devices that make it possible greatly to reduce the number of pole traps and at the same time to retain the effectiveness of those used against predatory birds are (1) tapering the tops of most of the fence posts to a point, or (2) guarding flat-topped posts by inserting in each an erect, slender wire to prevent large birds from perching upon them. If all the ordinary fence posts are so treated and only selected posts or poles provided with traps, the large birds will be driven to the latter when they seek to alight. Some hawks habitually perch to watch for prey, and while these are the species least destructive to birds, they are the very ones that are most frequently caught in pole traps. The bold, dashing bird hawks are more apt to come skimming over the tops of fences and pounce without a pause upon the first victim that offers.

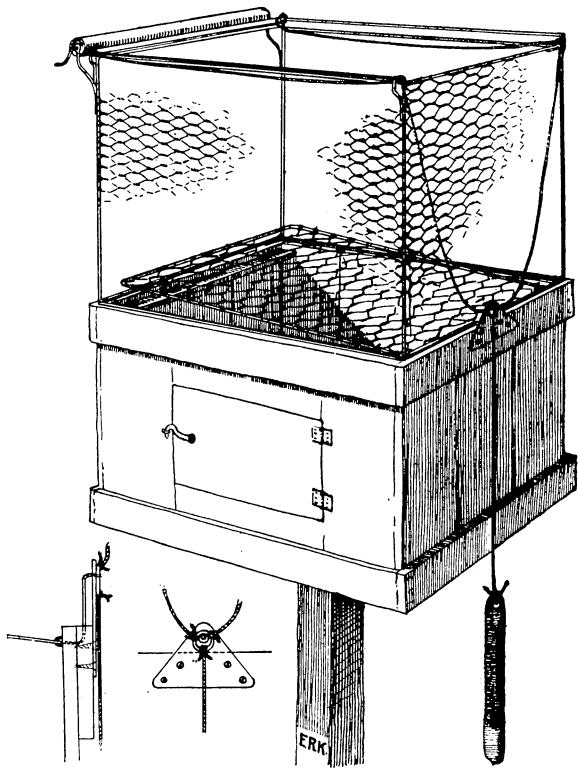


FIG. 5.—Basket trap for hawks. A live chicken or pigeon is kept in the lower part of the trap for bait. A hawk endeavoring to strike the fowl depresses the wire netting floor of the upper part of the trap, releasing the weight, which pulls over the top of the trap the rolled curtain shown at the left

Because of their selective destruction of the less harmful hawks, and of their danger to bird life in general, pole traps should be abolished as rapidly as practicable. Traps that capture birds alive should be substituted for them, so that harmless species can be released. Suggestions for such a trap are given in Figure 5. A cage with live hawks or owls in it attracts other birds of these kinds, and may be placed near a pole or basket-trap to decoy such visitors to the farm.

⁵ Bird Notes and News reports that the use of pole traps is now prohibited in England, Bavaria, and Prussia.

SHOOTING AND FRIGHTENING

Patrolling the game farm by an armed man with a well-trained dog is probably as satisfactory a method for the control of diurnal vermin as can be had. This conclusion rests on the supposition, however, that the man knows his business and does not blaze away at everything alive on the place except the game birds. The man can be and should be selective in his war on vermin. His presence, together with an occasional shot from his gun, should have a strongly deterrent effect on the visits of winged vermin, and his watchfulness and activity should strictly limit depredations by ground vermin. More crows and hawks can be killed by using an owl decoy and by shooting from a blind or cover than by other methods. Crows also can be poisoned with eggs treated with strychnine, but these should be placed so that valuable animals can not get them.

Where patrolling is carried on, scarecrows (fig. 6) may have some value. When manlike figures are always stationary, birds become



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FIG. 6.—Scarecrow in rearing field. The inner support is a crosslike frame. An outer stake is inserted in head. Bright sheets of tin, so arranged as to turn with every breeze, are suspended from ends of arms

accustomed to them, but when there is also some patrol work, with moving about and shooting, the warning effect of the stationary figures is much greater.

SHIPPING GAME BIRDS AND THEIR EGGS

Troubles in shipping game birds, varying from minor mishaps to disasters, some of which might not even be imagined by the novice, have been encountered from time to time, and for the most part are guarded against, by experienced breeders and dealers. For shipping a few birds, nothing surpasses a roomy basket of the grape-basket type. Such a container is light, and the prominent upstanding handle reduces the chances of its being thrown about and also prevents piling other objects on top. The basket can have holes to admit air and light but these should be so small that the birds can not possibly stick their heads through them. The top should be close-fitting and firmly fastened (figure 7).

A crate suitable for shipping a considerable number of birds when it is desired to send them in one lot, as for exhibition purposes, is

illustrated in Figure 8. This crate is 5 feet long, 27 inches wide, and 14 inches high. The ventilating crack extending all around is seven-eighths of an inch wide. The sliding panel in front, when closed, is screwed into position to prevent tampering with the birds. Whatever sort of shipping container is adopted or improvised, a few general principles should be observed.

The container should be so built that it will have a definite and easily recognized top side or even so that it can not possibly be set on that side, in order to minimize the risk of overturning. Also the top should be distinctly marked "Handle with care," "Do not delay," "Live birds, rush," or with similar conspicuous signs. Light should be admitted to the container, but there should be no holes through which the birds can put their heads and no openings about the lower sides or bottom through which their feet might slip. The inside should be high enough to permit the birds to stand fully erect. Slatted coops or boxes with wide cracks can be lined with cheesecloth. All nails should be well clinched. A good layer of shavings or other absorbent material should be provided on the bottom, and for a trip of any length the top of the cage should be padded inside with excelsior, straw, or the like under cheesecloth or burlap to prevent the birds injuring their heads.

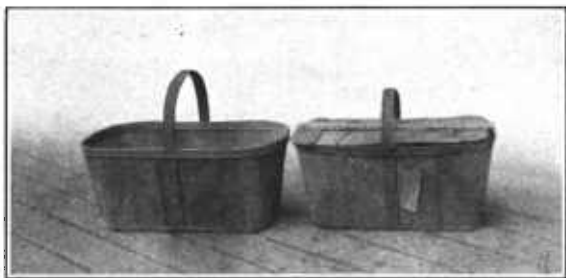


FIG. 7.—Baskets for shipping young pheasants



FIG. 8.—Crate for shipping game birds

Expressmen and others should not be depended upon for feeding and watering the birds, for they may fail to do it or may give them something that will be injurious. For a 24-hour trip food and water can be dispensed with, but for longer trips food hoppers should be fastened firmly to the inside of the cage and charged with enough of the birds' ordinary rations and grit for the trip. As a substitute for water, heads of lettuce or halves of apples, beets, turnips, carrots, or the like may be fastened to the ceiling where they will remain clean. Large lots of birds on an extended trip, or other especially valuable shipments, should have a caretaker traveling with them. In other cases advance notice of shipment should be given by mail or telegraph. Different species of birds or different sizes of young should not be mixed in the same crate, as the larger birds will fight and injure the smaller.

EGGS

Eggs should have individual wrappings. Some shippers wrap the eggs in two long strips of newspaper, one applied at right angles to the other; others twist them up tightly in wisps of hay. The outer packing for these individual eggs may be shavings, excelsior, hay, or similar shock-absorbing material. The best containers are baskets of the oblong grape-basket or the round peach-basket types. Both are light and suggest careful handling, and neither can readily be stacked with heavier objects.

LIBERATING GAME BIRDS IN COVERTS

The great object in liberating game birds is to do it in such way that they will tend to become localized. If the time chosen is near evening the birds will not have time to wander far before roosting. Put down the shipping container near natural or felled brush cover, scatter suitable food about it, open only enough for the birds to creep out gradually, and promptly leave the scene. When returning to the spot for the basket or coop or for feeding, which should be kept up regularly until the birds are established, approach cautiously and keep dogs and other animals away from the spot as much as possible.

IMPROVING COVERTS FOR UPLAND GAME BIRDS

The favorite resorts of upland game fowl have long been known as coverts, no doubt on account of their being admirably adapted to covering or concealing the birds. Such coverts are usually characterized by an abundance of low but dense and stiff or thorny shrubbery, together with luxuriant growths of grasses and weeds. These plants supply also an important part of the food of the birds.

Bobwhites frequently use coverts of rose, alder, bayberry, sumac, and blackberry bushes, and dense banks of honeysuckle. These plants furnish food for the birds, but they should be supplemented by others more exclusively adapted for the purpose. The quail is especially fond of mulberries in addition to those previously mentioned. Among valuable seed-bearing plants are Japanese clover, beggar lice, buckwheat, sorghum, broomcorn, kafir corn, millet, wheat, vetches, cowpeas, and any plants of the pea family producing small seeds. These are sown in large quantities in cultivated areas known as feed patches. The seeds of milk pea,⁶ partridge pea,⁷ hog peanut,⁸ wild bean,⁹ and smartweeds,¹⁰ are important natural foods of the eastern quail, but their growth should be encouraged only where they will not become weed pests. Western quail are fond of the seeds of sumac, bur clover, alfalfa, lupines, napa thistle, and turkey mullein, but where these plants are likely to become nuisances the food species recommended for the eastern quail will serve. The Hungarian partridge, like the bobwhite, thrives in open country, where often the chief cover is furnished by growing crops, hedges, or brushy fence rows. Improved coverts for the bird may be made, however, by planting much as recommended for quail.

⁶ *Galactia*.⁷ *Chamaecrista*.⁸ *Falcatia*.⁹ *Strophostyles*.¹⁰ *Polygonum*.

Coverts for grouse, as the sharp-tailed, should abound in such plants as rose, sumac, blueberry, bearberry, buffaloberry, snowberry, dwarf birch, and alder. The ruffed grouse thrives among scrub oak, bayberry, rose, sumac, dwarf birch, alder, poplar, willow, and such fruit-bearing plants as partridge berry, hawthorn, shrubby dogwoods, viburnum, wild grape, mountain ash, blueberry, blackberry, and cranberry. Cover of this nature is suited to pheasants also, but it is well to supplement the food supply furnished by these shrubs and trees by planting small grains and legumes as recommended for quail. None of these game birds should be released in dense woodland. Brushy ravines, overgrown pastures, or other waste land about farms are much better. Recommendations as to specific kinds of fruit-bearing shrubs attractive to birds and adapted to various parts of the United States are contained in Farmers' Bulletins of the Department of Agriculture, which can be had free upon application.

PRIMARY STOCK

The United States Department of Agriculture has no game birds or their eggs at its disposal, and notwithstanding press notices to the contrary never has distributed any of them. Some of the State game departments from time to time distribute certain game birds or their eggs, but the regular sources of supply are game farms and commercial dealers. Addresses of these can be obtained from the Biological Survey, United States Department of Agriculture, Washington, D. C.

It is more economical, as well as desirable in other respects, to start with adult birds purchased late in fall, for these will then be well settled in their new home before the breeding season, and the owner will have learned something about handling them before the busy and critical laying and hatching season arrives. Releasing the birds in pens should be done in the same manner as described for loosing in coverts (p. 12). In the case of penned stock the flight feathers of one wing should always be clipped before the birds are released.

To obtain initial stock from the wild, it is necessary to have authority for capturing the birds from State game departments in the case of nonmigratory, and from the Biological Survey in the case of migratory game birds. (See paragraph on Licenses, pp. 1-2.) Beginning with wild stock involves delays while the birds are becoming accustomed to restraint, which can be avoided by using propagated stock.

RING-NECKED PHEASANTS

ORIGIN AND DISTRIBUTION

More pheasants are raised by man than any other kind of game bird, and probably nine-tenths or more of the total number of pheasants reared in this country are ringnecks. Earlier importations and rearing operations in the Eastern States centered about the English ringneck, a hybrid developed in England between the common or black-necked pheasant and the Chinese pheasant. It is said that the Japanese pheasant also was freely crossed with the English hybrid. There are some pure blacknecks in the country and this race no doubt has been released in stocking operations. Some Mongolian pheas-

ants, another ring-necked race also have been used. In the Northwestern States, where pheasant-stocking operations have been very successful, the Chinese ringneck has been used almost exclusively; this variety has been distributed in large numbers also by the New York State game farms. An individual pheasant from coverts in the United States is very likely, therefore, to be of hybrid breeding but is fairly certain also to have a preponderance of Chinese blood.

This hybrid ringneck has a variety of qualifications that fit it for propagating and restocking operations. It is polygamous and prolific and, while sufficiently controllable to be a success on game farms, retains its wariness and wildness so as to be well able to take care of itself when released. It is considered a hardier and gamier bird and has not lost maternal instincts to the same extent as has the English ringneck—an important point in relation to the increase of planted birds. Cold weather does not seem to hurt the ringneck; in fact, the bird has thrived best in the northernmost States. In the South, on the contrary, it has hardly succeeded at all. Numerous other pheas-

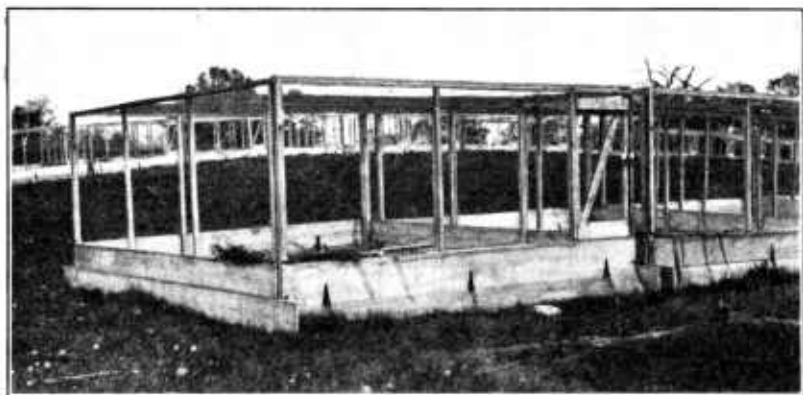


FIG. 9.—Pheasant breeding pen

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ants have been hand reared and even used for stocking purposes, but for various reasons, as lack of hardiness, inadaptability to large-scale rearing methods, wildness, or sterility in captivity, none has proved worthy of comparison for general purposes with the ringneck. For an account of these pheasants see the section on aviary or fancy pheasants, pages 35-36.

REARING EQUIPMENT

As previously mentioned, the use of ground free from the germs of disease and the renovation of fouled ground before reuse are controlling factors in systems of pheasant rearing. Though differing in details, all systems are adapted to meet these hygienic requirements. No one uses really permanent pens for pheasant rearing, for sooner or later new or thoroughly renovated ground must be had. So instead of speaking of temporary and permanent pens as distinctive of two types of rearing equipment and two schools of rearing methods, it is more accurate to refer to the small-pen and the large-pen systems.

SMALL-PEN SYSTEM

The keynote of the small-pen method of rearing pheasants is mobility. Not only are pens movable but they actually are moved at regular intervals to plots of fresh, uncontaminated sod.

BREEDING PEN

Within limits the size of the breeding pen can be regulated by the dimensions of available material. A common size is 12 by 16 feet on the ground and 7 feet high. (Fig. 9.) At the bottom of each wall are two boards, each a foot wide. These solid lower sides of the cages are important in preventing annoyance to the birds by dogs or other animals running about, and except for expense and weight could well be higher. At a slight additional expense the owner of only a few of these pens can improve them by making a higher screen of burlap.

The lower board on the long sides projects a foot at each end and is rounded off like a sled runner and in it is a hole for inserting a lifting or pulling device. The lower board on each of the short sides is

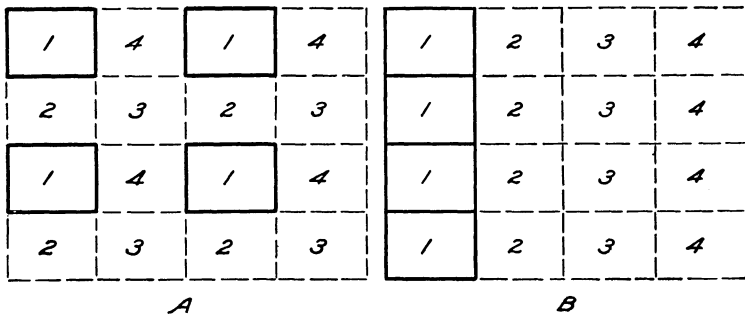


FIG. 10.—Systems of moving pheasant pens

hinged to swing outward. When these are lifted the cage can be slid over the ground without damage; the swinging boards also permit the transfer of the birds to an adjacent cage with little disturbance.

A few hints on moving methods may be of value. Horses can be attached to the runnerlike sides, but this method is more apt to result in damage to the pen than is hand moving. For the latter purpose large, strong, iron hooks with comfortable crosswise handles greatly facilitate a combined lifting and dragging movement by men. By dragging them slowly the pens can be moved short distances with the birds in them. When they are to be moved farther the birds should be placed in a small coop, and it saves wear and tear on the breeding pens to carry them on the platform body of a low wagon or truck.

Some foresight must be used when placing the pens to allow for regular moving to fresh ground. Two systems each bringing the pen on four different plots of grass in three moves are illustrated in Figure 10. With this number of moves the pen stays in one place from 10 days to two weeks. For weekly moving, nearly twice as many units of land would have to be provided, and this can be more

easily done by the solid row arrangement and longitudinal moving system shown in Figure 10, B.

Details of construction of a breeding pen are shown in Figure 9. The uprights are of material 2 inches square, and the corners are reinforced by seven-eighths-inch slats nailed over the netting. Two bolts are placed through the framework at each corner and a short brace across each corner at the top of the boarding. The door is large enough for a man to enter. The netting throughout is ordinary 2-inch-mesh chicken wire. Along the side of the cage the uprights are clear of the ground, as shown in Figure 11, and those on front and back do not extend below the upper board, arrangements that make it easier to slide the pen over the ground.

Some breeders provide a shelter by adding a board projecting inward from the lower part of the wall; this serves to keep a spot of ground dry where the birds can have a dust bath. Brush shelters

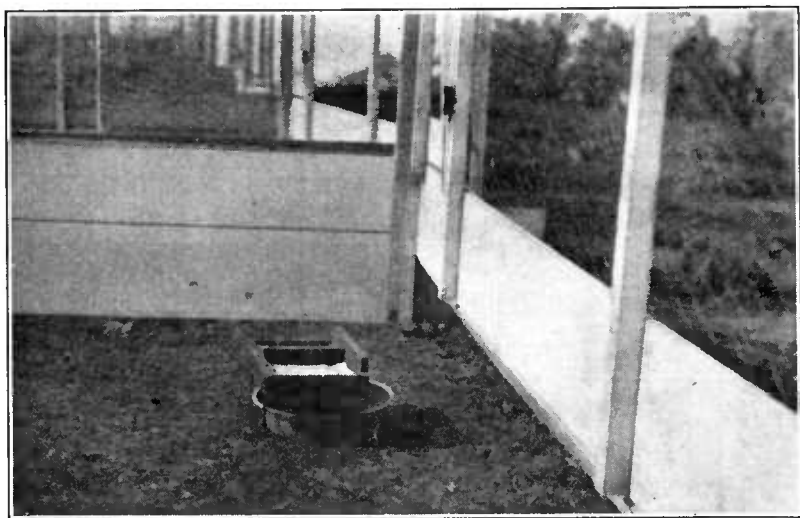


FIG. 11.—Neat combination of food, grit, and water containers

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under which the birds can hide and where the hens can resort for laying are essential; if they are attached to the pen as shown in the illustration they will cause no trouble in moving.

Receptacles for food, grit, and water should be standardized and durable; the combination shown in Figure 11, in which the food and grit box shades the water pan or crock is a good one. It should be set near the door of the cage so that it can be emptied, cleaned, and refilled with the least disturbance to the birds. In hot weather, water must be replenished more often than food, so it is poured from a spouted can from outside the pen. One dash of water cleans and empties the pan, and a less violent pouring refills it. Breeding pens as well as all other inclosures for game birds should be so placed or constructed as to give the birds plenty of both sun and shade.

The function of the breeding pens is to house, protect, and keep the birds in such condition that there will be the maximum production of eggs. When the eggs begin to come in large numbers,

other equipment is immediately needed. Methods of caring for the eggs until they are put under the hens are discussed on pages 25-26.

HATCHING COOPS

For convenience and economy hatching coops are so planned that they can be used not only for housing the hens while they are incubating but also later when they are moved to the rearing fields to brood the young birds. The hatching coop illustrated in Figure 12 is 2 feet square, 23 inches high, in front, and 12 inches at the back. The slatted door (1 foot high) is so constructed as to close, or, if slid to one side, to expose all openings between the slats forming the front of the coop. These slats are spaced so that the young pheasants can run freely in and out of the coop, but so as to confine the hen. When it is desired to release her the sliding door shown at the left of the picture is raised.

The roof of the coop is 30 inches wide and 31 inches long and is provided with cleats on the lower side about 4 inches from each end that fit inside the walls of the coop and hold it in place. It should be nearly or quite rain-proof. The coop is made of $\frac{7}{8}$ -inch material and may look clumsy and heavy, but there is good reason for this construction. Storms do not easily unroof or overturn the coops and they stand wear and tear better.

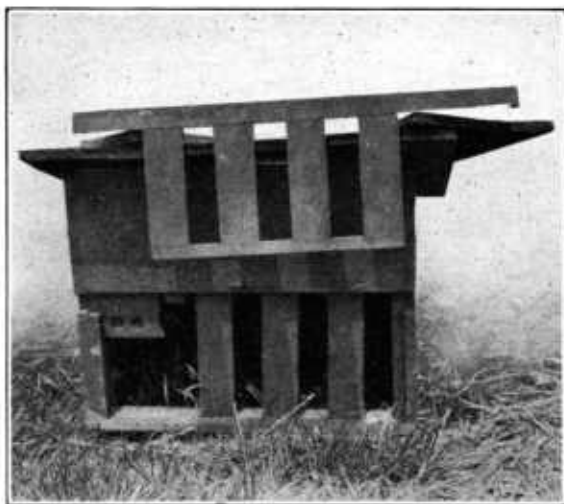


FIG. 12.—Hatching and brooding coop

The roof should be weighted if necessary to prevent strong winds blowing it off.

In the view showing the interior of the hatching coop (fig. 13) is the nest holder, a frame 5 or 6 inches high and 16 inches square. One of these frames is used to hold the nest in shape, and a second is placed on top of the other at hatching time to prevent the tiny young from scrambling away from the warmth and shelter of the hen, which are so necessary to them at first. The hole in the upper front of the coop shown in Figure 13 is for administering sprays.

EXERCISING RUNS

For convenience and economy of time the hatching coops are arranged in rows with space at the sides about equal to their own width, and sufficient in the other direction to allow for a path and to accommodate the exercising runs. (Fig. 14.) These runs are simple frames, 36 inches long, 27 inches wide, and 23 inches high, covered

with chicken wire on top and with 1-inch-mesh netting on two sides and one end. The top is removable, and the drinking cup is attached to the frame. These runs fit the front of the hatching coops and



FIG. 13.—Interior of hatching coop

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provide a place where the hen can exercise, be fed and watered, or confined whenever it is desirable to exclude her from the hatching coop.

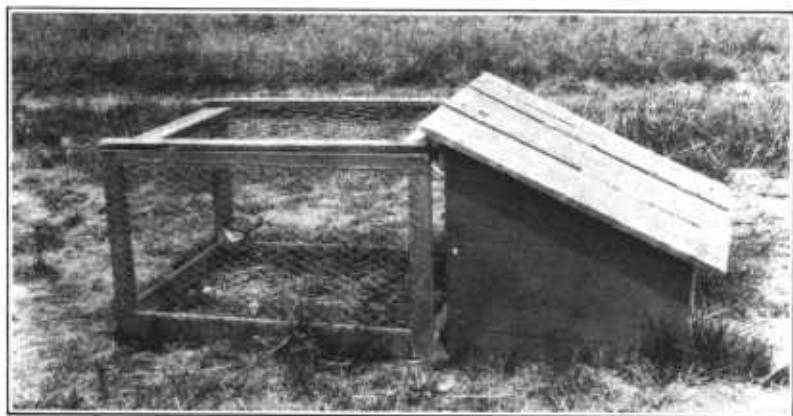


FIG. 14.—Hatching coop with exercising run

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COMBINATION COOP

A combination hatching coop and exercising run is illustrated in Figures 15 and 16. The body of this is 30 inches square and is provided with two cleats on each side, so placed that a partition slid in

them will divide the interior into two approximately equal compartments. The corner posts are $1\frac{1}{2}$ inches square and the cleats of $\frac{7}{8}$ -inch and the walls of $\frac{1}{2}$ -inch material. The door on the side, 8 inches square, is hinged at the bottom and fastens with a button at the top.

The front of the combination coop is of 1-inch mesh, with a 3-inch slat across the bottom hinged to open upward, thus providing a place for the chicks to pass through. The button mounted on the block at the left side (fig. 16) holds the slat in position when fully opened. The coop is 18 inches high in front, 20 inches at the middle, and 15 inches at the rear.

The roof overhangs all around, and the back section is hinged and strengthened beneath by three cleats cut so as to hold it firmly in place when closed, the upper two cleats fitting inside the body of the coop, and the lower one outside. The front half of the roof is provided with two blocks upon which the rear half rests when open. This prevents undue strain on the hinges, and makes a level surface on which the caretaker may place anything he may wish to set down for a moment.

Breeding cages and hatching and rearing coops with their accessories are the principal items of material equipment for the pheasant breeder using the small-pen system. Besides these there are rearing fields and summer and winter ranges, which may be called environmental equipment.

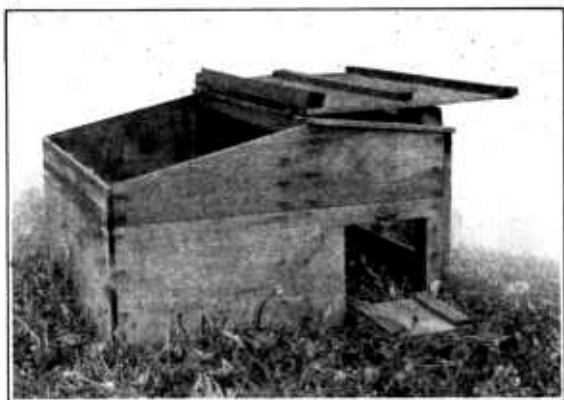


FIG. 15.—Combination hatching and brooding coop (side)

REARING FIELD

So far as its vegetation is concerned, the preparation of a rearing field has been discussed under crop rotation (pp. 2-3). Rearing fields should be on the higher or more rolling parts of the farm, well drained, and if possible with mellow, warm soil. The rank growth so desirable for the rearing field should consist partly but not entirely of clover, since a thick growth of clover alone holds too much moisture.

Shortly before the rearing field is needed for use single swaths should be cut in it from 50 to 100 feet apart. The hatching coops should be spaced 50 to 80 feet apart in the swaths, so as to allow for moving them 3 or 4 or more feet daily for 8 to 10 days. (See illustration on title-page.) The shorter grass in the swaths makes the work of the keepers in moving coops, watering, and feeding far easier and renders it less disagreeable on dewy mornings. The coops can be kept close to the uncut grass, so that the pheasants can easily

reach it when taking cover. They will work all through it in their search for insects and small seeds. A little banking of soil around the coop is sometimes necessary to prevent water from draining into it. The coops should be placed on the rearing field a few days before needed, and in fine weather, so that the ground under them will be dry.

LATE SUMMER RANGE

After the breeding season is over, it is desirable to have a fresh and ample range for birds that are to be held for the next season. These consist of about equal proportions of selected breeders of the current year and of two-thirds-grown young as they come from the rearing fields. Their late summer range should be land that has been prepared in much the same way as the rearing fields but from which

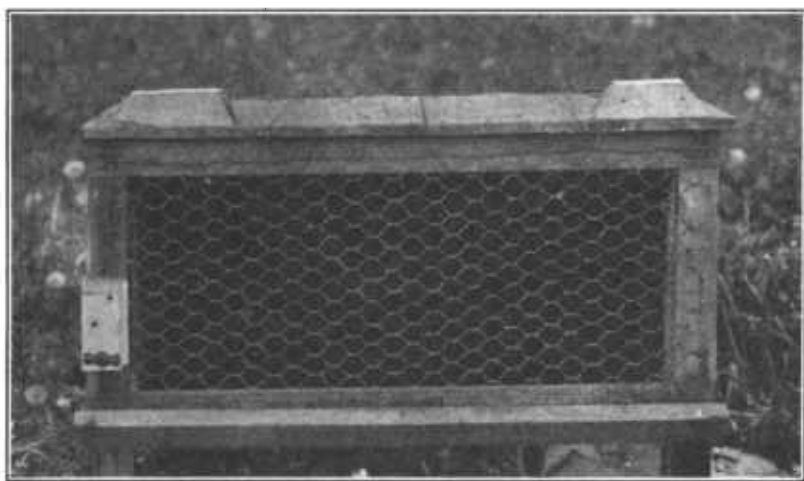


FIG. 16.—Combination hatching and brooding coop (front)

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more or less hay can be cut before the pheasants are put on it. It should be so managed, however, that when needed several long strips across the field will have well-grown stands of millet, buckwheat, sunflowers, sorghum, or corn, which are valuable in providing both food and cover for the birds.

WINTER RANGE

Wooded rolling land with sheltered openings is ideal for winter range. (Fig. 17.) A few trees felled before the leaves have fallen or piles of evergreen brush will serve as refuges from winged enemies. In addition to plentiful ground feeding, which will encourage the birds to exercise, weatherproof food hoppers should be freely provided and kept filled. Patches of rape make an excellent supplement to the winter food. Arrangements for watering should be adjusted to weather conditions. A stream or pond on the winter range solves the watering problem, but in the absence of either, receptacles will have to be provided and kept free from ice as much as practicable.

Birds can be carried over the winter in more restricted quarters but at the price of increased labor. Windrows of brush or straw supported by wire-netting fences can be used as windbreaks, and all food can be scattered in deep straw so as to keep the birds working for their living. (Fig. 18.) All the straw, however, should be cleaned up and renewed weekly if not oftener.

LARGE-PEN SYSTEM

Under the large-pen system, the management of pheasants is practically the same as under the small-pen system, except in the matter of equipment. It is well to bear in mind in this case not to build too solidly or expensively. Shallow setting of posts, light stapling of wire netting, and the like will help when the inevitable moving time arrives, and it may come suddenly and unexpectedly.



FIG. 17.—Open winter range for pheasants

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BREEDING PENS

Breeding pens may be 200 by 400 feet or larger and contain 250 or more birds. The sides should be of 1-inch mesh and the top of poultry wire, but it is well to have 2 feet or more at the bottom made of boards (the lowest sunk in the ground) to provide shelter from winds, to exclude vermin, and to prevent dogs or other animals that prowl about the pen from annoying the birds. Where vermin is especially troublesome the lowest course of the sidewalls can be of one-half-inch mesh wire netting extending 1 foot vertically into the ground and then outward 6 inches at right angles.

Shelter sheds (some of them built so that they can be used in trapping the birds) are usually provided along the side from which most severe weather can be expected, generally the north. The overhead netting must be staunchly supported to resist the weight of snow and sleet. In the case of uncovered yards, a section is partitioned off and roofed with netting to provide a place where the birds can

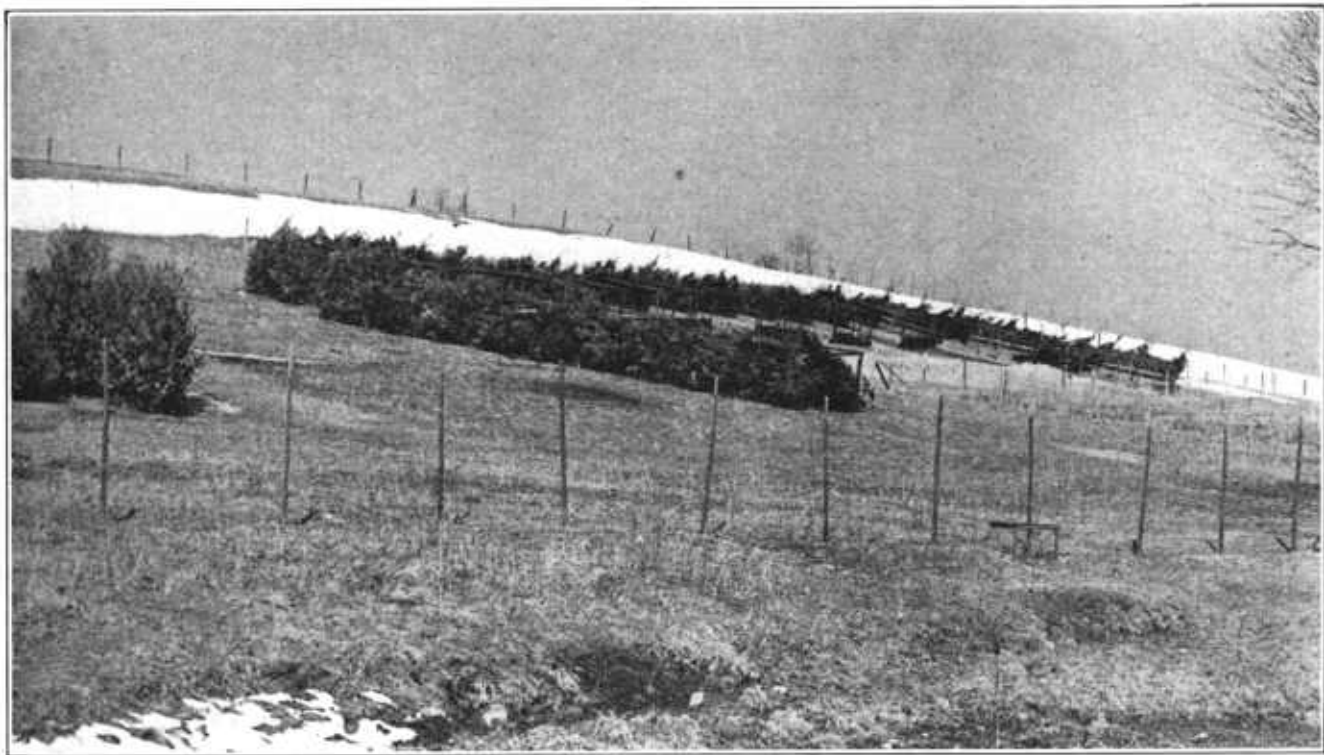


FIG. 18.—Concentrated winter range for pheasants

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be driven at night and be safe from enemies. The large breeding pens should have numerous piles of brush, under which the birds can take shelter, and ample food and water receptacles.

These large breeding pens are usually built in pairs, so that one can be spaded and limed or cultivated and planted for a season while the other is in use. Even so the pens are moved to a new location after a few years.

Although much less expensive than small movable inclosures capable of housing the same number of birds, large breeding pens have certain objections urged against them. It is said that egg production does not average so high as in the smaller pens and that much more trouble is experienced because of fighting among the birds. Cocks are killed in fights during the early breeding season, and a less vigorous cock or a hen on which a wound is started during treading is soon worried and pecked to death by the others. Such occurrences rarely happen in the smaller breeding pens.

HATCHING BOXES AND HOUSES

Some of the hatching shelters are scarcely larger than the coops described under the small-pen system, but they differ in that they are built according to the battery system. In the simplest form nesting boxes are built in units of six compartments each, which have ventilating holes on three sides and a door in the other. Small feeding boxes in a series built to correspond are placed against the hatching boxes and the hens transferred to them for feeding and watering. The feeding boxes have a slatted front and a trough along it for the reception of food. Hatching coops can be kept out of doors without other shelter, in which case the eggs usually do not need to be sprinkled with water. At one game farm it was found that a common feeding and exercising run for the hens was best, as the birds thus mingled were placed on different nests from day to day, and the effect of differences in their body heat thus being equalized a more even hatch was obtained.

Aggregations of these hatching boxes are sometimes kept in a hatching shed that has removable sides, so that it may be kept cool. For the same reason the floor of the shed, the hatching coops, and other things in the shed are sprinkled daily in hot weather. The turf or peat used for the foundations of the nest in the boxes is saturated with water at the time of building the nest, and in unusually hot weather the eggs are sprinkled occasionally.

An item of equipment sometimes accompanying the batteries of hatching and feeding boxes is a box of six compartments, each with a sliding top, which, loosely filled with straw, is used in transferring the young from the hatching shed to the rearing field.

LATE SUMMER PEN

The size of the late summer pen may be whatever available funds will permit. The lower sides are of $\frac{3}{4}$ -inch mesh wire netting and the upper sides and roof of 2-inch mesh. The lower edge of the fence is buried in the ground or attached to a tier of creosoted planks so buried. The inside height of the pen is sufficient to permit culti-

vating and planting operations. Rape is the favorite crop. Birds of the season to be used for stocking shooting coverts are kept in such a pen until needed, as well as birds that are to be wintered, until they have completed the molt and have been wing-clipped. Then they have an uninclosed range, as described on page 20, as well as the run of a winter pen, as here described, which is left open and in which hand feeding is continued.

INCUBATORS

On most pheasant farms incubators are used only in emergencies, as when broody hens are not available in sufficient numbers when needed, when hens stop incubating and there are no substitutes, or sometimes to serve the purpose of brooders for short periods when very young chicks are chilled by drenching cold rains or other unreasonable manifestations of the weather.

On the Massachusetts State game farm, however, incubators are exclusively used for hatching pheasant eggs. The eggs are stored in a cellar and turned daily as under other systems of pheasant rearing. (See pp. 25-26.) Six hundred eggs are incubated in a machine in one batch. The temperature is kept at $102\frac{1}{2}^{\circ}$ F. for the first week, then raised to 103° . The eggs are turned twice daily, tested on the twelfth and eighteenth days, and infertile eggs removed. Hatching begins at the end of the twenty-second day, and the young are kept in the incubators about one day after hatching. Then they are transferred in woolen-lined baskets to the brooders.

BROODERS

Coal-burning brooders similar to those used for poultry, with the addition of wire-cloth guards to keep the young pheasants away from hot parts, are employed at the Massachusetts farms. Brooder houses warmed by a series of pipes from a central heating furnace also are used, but the pipes are high enough from the floor to clear the heads of the young pheasants and are covered with burlap and a sheet of composition board to prevent the birds from being burned by perching upon them. The temperature in the brooder compartments is kept at about 100° F. for the first 10 days, then gradually lowered to 90° .

That the birds may have exercise and get water whenever desired, the houses are lighted with electricity at night. Every compartment is washed, cleaned, and fumigated after occupancy by a batch of young birds. Half the floors of the brooder rooms are covered with pine needles and the other half with screened sand.

The brooder houses open on wholly inclosed wire runs divided into four compartments, each sown to clover or buckwheat. For quick results the buckwheat is sprouted before sowing. The birds are admitted successively from one division of the run to another as the green growth is depleted. If the planted food does not become available as soon as needed, chopped lettuce is substituted. Brush is kept in the runs so that the birds will learn to take cover.

At night the young birds are driven back to the heated compartment, but as the time for distributing them approaches the houses are ventilated at night, thus hardening the birds in preparation for

exposure outdoors. The birds are confined to the brooder house five or six days, and progress through the sections of accompanying runs at the rate of about one compartment every two weeks. They are distributed to coverts at 8 weeks of age.

INCUBATOR-BROODER SYSTEM

The percentage of eggs hatched by incubators (60 to 75) is less than that obtained under hens (80 to 90), and the losses of young in brooder houses are greater on the average than in rearing fields. On the other hand, equipment under the incubator-and-brooder system is less complicated, less expensive both initially and in the upkeep, and less troublesome to manage than are the hens, the hatching and rearing coops, and the rearing fields needed under the foster-mother system.

It is uncertain at present to which system the balance of economy would incline in the long run. Economy is not the whole story, however, and breeders using the more natural methods of pheasant production believe that incubator and brooder raised birds can have neither the vigor and vitality of those hatched under hens and grown outdoors in roomy rearing fields, nor the same degree of wildness, a vital factor in enabling them to escape natural enemies when distributed to coverts.

It is also urged, and this applies to both rearing systems, that a true measure of the effectiveness of a game farm is not afforded by the number of 6 to 12 weeks old birds it releases, but by the number that actually reach maturity. In most stocking operations this number is entirely unknown, but on game farms where birds are held for stocking coverts at the shooting season or are reared for sale at maturity the net results of operations can be definitely ascertained.

CARE OF EGGS AND OF YOUNG AND ADULT BIRDS

EGGS

The eggs are gathered from the breeding cages every afternoon, with as little disturbance of the birds as possible. Baskets and buckets are the usual containers, and when all the eggs are collected they are taken direct to a storeroom, where tables with a thick layer of sand, oats, bran, or other poor conductor of heat await them. It has been stated that sawdust, shavings, and excelsior are undesirable for this purpose, as they contain some oily matter, which may clog some of the pores of the eggs and interfere with respiration of the embryo. The eggs are placed on the tables in rows touching each other and are turned twice daily, morning and evening. In order that the handler may know which eggs have been turned, the more pointed ends of all should be placed in the same direction the first day.

A dry, cool cellar is an ideal storage place for eggs, and when the temperature ranges from 40 to 50° F. they may be kept safely for 10 or 12 days before setting. When a cellar is not available the storage room used should be dry and sunlight should be largely excluded.

Putting all eggs through this curing process and not setting them direct from the breeding cages, except in an emergency, contributes to uniform hatching. Time and energy will be saved, as a rule, by allowing eggs to accumulate until enough are on hand to set all the available hens. When there are more hens than are needed for one rearing field, set only enough to produce young birds up to the full capacity of that field. Eggs abnormal in any way should be rejected.

MAKING THE NESTS

After the hatching coops have been disinfected by dipping in an antiseptic solution or by thorough spraying with a commercial louse-killer, a square of sod should be taken up and some of the soil removed from the underside so as to permit formation of a slight depression. This sod should be thoroughly drenched with water and placed on that where the coop is situated, giving enough elevation to assure that no damage will be done by heavy rainfall running in. Over the sod a smooth nest of straw or hay should be formed, dusted well with pyrethrum powder, and lined with grass clippings well worked in.

INCUBATING

Preferences vary as to the type of hen to use for incubating pheasant eggs, but in general unfeathered legs, small size, and quiet disposition are desirable qualities. Hens obviously affected by scaly leg or any other fowl malady should not be used. Turkey hens formerly fancied by some breeders would seem most unsuitable; there is even a tendency to replace these birds with other poultry for the incubation of their own eggs. It is highly desirable that the pheasant farm have a flock of poultry¹¹ amply large to supply the number of sitting hens needed, but sometimes the crowding production of pheasant eggs makes it necessary to search the country far and near to obtain the necessary broody hens.

When such hens are on hand, it is well to accustom one for a few days to each hatching coop that it is planned to use. Putting in a few hen eggs may persuade her to adopt the nest, but these should not be replaced with pheasant eggs until the hen seems well settled down to her task. When satisfied regarding this requisite, place the pheasant eggs in a single layer in the nest, 15 to 18 of them according to the size of the hen, dust the hen thoroughly with pyrethrum powder and allow her to return to the nest. Inspection in a short time will reveal whether she has properly adopted the eggs; and if so, she may be left in peace. If the hen does not promise to be a good close sitter, the eggs should be given to another at once.

During the 21 to 24 days' incubation period the hen should be carefully removed from the eggs and liberated in the exercising run once daily at a regular time, fed sparingly, and watered. If the day is warm she may remain off the eggs for an hour perhaps, but if cold or wet, the period should be decidedly reduced. The nest should be inspected daily for the purpose of removing broken eggs, washing

¹¹ Information on all phases of poultry raising may be obtained by application to the Bureau of Animal Industry, U. S. Department of Agriculture.

soiled ones (in tepid water without soap), or rearranging the nest and eggs if not in the smooth and orderly condition necessary to get best results from the body warmth of the hen. It may be necessary also to turn the eggs, as not all hens attend to this necessary detail. In dry weather the eggs should be sprinkled occasionally with tepid water.

Care should be taken to keep close watch for lice, for if these become numerous they will annoy the hen so that she may give up brooding. In such case the coop should be disinfected, the nest renovated and powdered, and a new hen put on the eggs as soon as practicable. Meanwhile the eggs may be temporarily cared for in an incubator or in a flannel-lined basket by the kitchen stove. As a matter of routine, the hen should be dusted with pyrethrum after about 10 days of incubation, and again a few days before hatching time. Pure pyrethrum powder is insisted upon because some of the louse-preventive compounds contain ingredients that have been found injurious to young pheasants.

HATCHING

As the day approaches when hatching may be expected, the first signs of pipping should be watched for. From this time until the young birds are all hatched and thoroughly dry, the hen usually will stay continuously on the nest and should not be disturbed. The second story of the nest frame described in the section on Hatching Coops (p. 17) should be placed about her; this will prevent the tiny young from scrambling away from the hen, when they may perish from cold. Until the hen leaves the nest voluntarily after hatching she should not be fed or removed for any reason. She should have full charge of the young for 24 hours after hatching is completed. They do not need food at this time.

REARING

After this period the hen should be removed with her brood (the hen in a sack, the young in a covered basket well filled with straw) to a coop in the rearing field. The hen is then confined to the coop, which for the first three days should be provided with a small run made of three boards a foot wide to keep the young from straying. The lower edges of these boards and the walls of the coop should fit the ground closely and have no holes through which the pheasant chicks can escape. By confining the young for three days, they have a chance to get well acquainted with their foster mother, and what is especially important, to learn her calls. Some breeders maintain that this object can be attained by shutting up the birds for a few hours with the hen in the rearing coop.

After the fourth day the board run should be removed and the position of the coop changed a few feet every day. After the eighth day the hen may be allowed to roam with her brood and the coop moved every three days. The tendency of the young pheasants is to cease roosting under cover and sooner or later even to fail to return to the hen. If possible the brood should be penned in the coop at night when about 4 weeks old (otherwise they must

be trapped) and the flight feathers of one wing clipped for the first time.

At about seven weeks the birds to be retained as breeding stock, which should always be from early hatchings, are again trapped, clipped, and released into a fresh rearing field. Birds that escape over the fence before wing clipping will try to get back again by running along the outside of the fence. They may be caught in movable traps (fig. 2) or by the use of wings or netting flaring out from the fence and tapering down to a pocket in which they will crouch and can be picked up.

Those to be used for stocking purposes are not clipped but are kept in covered breeding pens regularly moved about on fresh ground, or in other suitable inclosures. Another method of handling such birds is to keep them clipped until a month before delivery. The stumps of old feathers are then pulled, and new ones will be grown in 25 to 30 days. Birds selected for planting must have the use of their wings to enable them to escape their enemies. Moving young birds away from the hens and coops to a rearing field where there is no shelter should be done in fine weather, not when there is likely to be a drenching rain soon after the change.

CARE OF BREEDING STOCK

The young birds that are being groomed as next year's breeders, together with any old birds that are retained, are successively transferred to the late summer and to the winter ranges. It is necessary to clip the flight feathers of the growing birds repeatedly; some breeders begin as early as four weeks, others make the first clipping at 12 weeks. This latter period falls about September 1 in the Northern States, and the wings are again clipped about October 1 and November 15. The partly grown primaries, never pinfeathers, of one wing only are cut off. The birds are thus unbalanced and efforts to fly tumble them to the ground. With both wings clipped balance is restored and a fair sort of flight is possible.

TRAPPING

At every wholesale movement of the birds trapping is required, and it is well to explain how this is done. A row of breeding pens is placed side by side across the field occupied by the birds. The hinged boards at the bottom of both ends are left open, and the food scattered for the birds in these cages. Have them in position a week before needed, reduce the quantity of food a day or so before trapping, then bait the traps liberally, carefully urge as many of the birds as possible inside, and let down the gates. Scattered birds not thus caught can be picked up in funnel traps set along the fences, or in general-purpose traps like that illustrated in Figures 2 to 4. A long-handled dip net with a ring and a bag of liberal size is used to catch the birds individually in the large traps. Such a net is handy on other occasions also for scooping up loose single birds. Do not flop it on top of a bird on the ground and thus risk injuring it, but pick the bird up with a sweeping movement that carries the net into the air, where the bag can be folded over the rim so as to prevent the escape of the captive.

MATING

In spring (late in March as a rule), when the birds are finally caught up for placing in the breeding cages, from 5 to 7, usually 6, hens should be placed with a single cock in each pen. Cocks are selected for size, vigor, and good condition of plumage, and surplus cocks are penned separately and all but a few disposed of as soon as practicable. When removed daily from the breeding cages, from 40 to 60 eggs¹² a season can be expected from each hen. Two and three year-old hens are the most productive, but without placing numbered bands on their legs or otherwise marking them, it is difficult to distinguish between these classes. Hence the practical thing to do to assure partial renovation of the stock is to keep for breeders birds of the year, and old birds of mixed ages, in equal proportion.

Bigger and more vigorous birds that will produce more eggs can be reared on the properly conducted game farm than can be purchased from so-called wild stock. If the pheasant breeder has healthy and fairly satisfactory stock, he had better gradually improve it than take the chances on devitalized stock and on the diseases and parasites that are involved in every importation of birds on the farm. Do not be perturbed by the bugaboo of inbreeding. That inbreeding is necessarily harmful is a completely exploded theory. If the stock is sound, inbreeding improves it. All leading breeds of domestic animals have been perfected by the closest sort of inbreeding. Select the very finest birds for breeders, give them and their progeny the best of care, and you need not worry about inbreeding or have occasion to import "new blood."

FEEDING

Feeding is so important a factor in pheasant rearing that it can almost be said that proper feeding insures success. Certainly improper feeding can utterly ruin ventures in which every other factor affecting the birds seems correct. Food on the game farm must not only have all the elements that the birds need to make growth and keep up their vitality, but it must always be clean—clean to the uttermost—must be mixed only as needed, fed in just the right quantity, remnants picked up, and in all ways safeguarded so that fermented or stale food shall be things entirely unknown. The vessels in which foods are mixed should be thoroughly cleaned and scalded after every time of using.

ANIMAL FOOD

Animal food is essential in the diet of young pheasants. This fact has been realized by gamekeepers everywhere, and their efforts to supply this vital element of the food have been diverse and often extremely laborious, expensive, or otherwise objectionable. Ants' eggs because of scarcity, meal worms because of unreliability of supply, and maggots on account of repulsive features connected with rearing them and their not entirely beneficial effects on the birds, have been tried repeatedly and by most raisers given up. Home-made curd, cottage cheese, custard, liver, and meat preparations also

¹² A maximum of 104 has been recorded.

have had and still have their vogue. The individual pheasant breeder, however, particularly if operating on a small scale, will do well to use commercial pheasant mannas, chick meals, and the like, the composition of which has been brought to a satisfactory state as a result of cooperation between manufacturers and breeders, and the manufacture of which is surrounded by all necessary sanitary precautions. The largest and most successful pheasant farmers depend to a great extent upon commercial foods, even if they do mix or recombine them to suit individual fancy.

The most important source of animal food for the young birds is the supply of insects that they can glean in the properly prepared rearing field, but this supply should always be supplemented by animal matter mixed with the vegetable food fed. The proportion of animal matter in the prepared food can be varied to suit conditions and can entirely replace the natural supply in the event this fails.

THE FIRST FEEDING

The first feeding of young pheasants should be in the run in which they are confined after being taken to the rearing field. It will therefore be shortly after they are 24 hours old. They are fed every three or four hours during daylight for the first week, and are given no more than they will pick up clean in a few minutes. It is better to keep them a little hungry than to overfeed them. The first feed is given as early as possible in the morning and the last as late as practicable. Some feed only custard (made in the proportion of 2 beaten eggs to 1 cup of milk and cooked in a double boiler), or grated hard-boiled egg the first day or two; others begin with a mash prepared as follows:

Mix thoroughly hard-boiled eggs, chopped fine, with an equal quantity of twice-baked bread or cracker that has been run through a coarsely set chopper that will break it up as finely as desired but will not pulverize it. The mixed food can be moistened with scalded sweet milk or boiling water, but only to an extent that will leave it an easily crumbled mash. Never give pheasants sloppy food.

Two boiled eggs and breadstuff mixed as described will make sufficient mash to provide three meals for 15 or 20 chicks. Whether feeding a large or small number of birds, never mix up more mash than will be consumed the same day, and it is safer to provide only for the next meal. So long as a hen is with the young pheasants the food given her should be of a type they can not eat; whole corn seems best, and boiled grain can be supplied if the hen has any difficulty digesting it when fed dry.

LATER FEEDINGS

During the second week intermediate chick-grain, rolled oats, or crushed wheat are added to the ration, but no sudden change should be made in the food at this or at any other period. Vary the mixture gradually. Three meals a day are given, of which breakfast may be of the mash advised for the first week; dinner, chick-grain or crushed wheat slightly moistened with water; and supper, the first-week mash to which has been added about a third of dry chick-grain, rolled oats, or crushed wheat.

When the young pheasants are 2 weeks old their meals may be reduced to two a day, morning and evening. Chick-grain, rolled oats, or crushed wheat, slightly moistened with water, or boiled wheat or rice, and an occasional feed of the first-week mash may be used. The birds are fond of clabber and of curd or fresh cottage cheese (no salt to be added), and these and the egg mash may form a larger part of the diet when insects are scarce in the rearing field, the weather is unfavorable, or when for any other reason the young birds are not making satisfactory growth.

From the fourth week until maturity, almost any dry small grains can be given, as oats, wheat, buckwheat, and scratch feed, but it is advisable, as a rule, to hold down the quantity of corn. It may be fed a little more freely in winter.

LARGE-SCALE FEEDING

The feeding program recommended in previous paragraphs is one practicable for the beginner or the small-scale operator. On large game farms more food manufacturing is carried on and more elaborate food mixtures are used. On one farm meat and bones from city packing houses are cooked, ground, and dried, and enter more or less into the diet of birds of all ages. Beef scrap and bone meal, buttermilk mashes, and other commercial articles are used by some. On large game farms a great deal of food cooking is done, even the small grain rations being scalded or cooked for the sake of softening and sterilizing them, and as a means of supplying moisture to the birds.

Following is an example of a mixed ration used for adult birds on a large game farm: Corn and oats in equal bulk ground together, 22 parts; middlings, 11 parts; bran, 11 parts; meal alfalfa, 5 parts. Mix with this 1 per cent of bone meal and half of 1 per cent of beef scrap on alternate days. For a few weeks prior to the laying season the proportion of bone meal or beef scrap is increased to 10 per cent of the whole. The alfalfa meal is scalded over night and the remainder of the mixture the day used; when cool mix in the alfalfa, and feed it only moist crumbly. If too wet, middlings or bran can be mixed until it becomes sufficiently dry.

Sprouted oats or buckwheat, mowings of these grains from field crops, grass clippings, lettuce, or any available green foods are valuable additions to the diet, especially of the breeding birds. In winter chopped mangels, beets, turnips, or potatoes may be used to supply fresh vegetable food.

A few details that should be observed in the preparation of pheasant foods may be emphasized. The food materials whatever they may be—grain, bread, crackers, eggs, or even bone meal—should be cut, not pulverized; in other words there should be the minimum of dust about such preparations. Powdered food can not be picked up by the birds or thoroughly cleaned up by workmen, and thus tends toward insanitary conditions. Powdery ingredients and too much moisture make sloppy food, and pheasants should never be fed slops. Receptacles and implements used in preparing foods should always be scrupulously cleaned, so that no sour or stale taint will ever occur.

DRY FEEDING

At least one successful American breeder has adopted the plan of feeding dry mashes from the very beginning. Commercial chick manna is used at first and gradually changed to a scratch feed and beef scrap combination. These dry foods are made available to birds in food hoppers, which need refilling only about once a week. The hoppers are under practically weatherproof shelters so that the food never gets wet. Plenty of drinking water is a necessary accompaniment to this feeding system, and it is supplied in capacious fountains of the type used by poultrymen. The great advantage of the dry-feeding system is economy of time; one man can attend to three or four times as many birds as under the wet-mash system. Another advantage is practical immunity of the birds from disorders that arise from soured food.

WATER

As a rule, fresh, clean water should be available to pheasants of all ages. Some breeders do not give it to young that are fed entirely on moist mashes. Since water generally must be kept in small open receptacles in the cages, it should be renewed daily as a rule, and more often in hot weather. In the rearing field there should be a small receptacle for each coop, and larger ones should be set in shady places elsewhere. Stoneware tends to keep water cool. All receptacles should be shallow and should be thoroughly scrubbed and scalded weekly. When fountains are used, they also are completely emptied and refilled daily. In large pens and on the later summer and winter ranges it is sometimes possible to supply running water, certainly a great convenience and labor saver.

GRIT AND CHARCOAL

A mixture of sharp grit, broken oyster shell, and charcoal is kept available to the birds at all times. The pens and ranges for adults have receptacles for this, but in the rearing fields finer grades of the same substances are thrown down with the food to supply the chicks.

VICES

EGG EATING

Some pheasants, especially cocks, form the habit of eating eggs. This is encouraged by permitting broken eggs to remain in the pens instead of cleaning them up thoroughly as soon as found. Increasing the proportion of animal matter in the ration may cure the trouble. If not, it can be discouraged by putting in the pens china or iron eggs painted to resemble pheasant eggs, or partially emptied eggs can be well spiced with kerosene and red pepper and placed in the pen where the trouble is experienced. In extreme cases the offending bird can be penned away from the others until the eggs are gathered, the upper mandible pared at the tip until it becomes too sensitive to be used for breaking eggs, or if the bird is (as usual) a cock, a surplus male can be substituted.

FEATHER PLUCKING

The vice of feather plucking is believed to result usually from a deficiency of animal food. Increasing the proportion of beef scrap or other animal element in the food is the remedy indicated. This vice seems more likely to break out where large numbers of the birds are penned together, or perhaps the effects become more rapidly apparent because of the more numerous aggressors upon birds that become the least denuded of feathers or weakened. Such individuals should be removed to isolation pens at once and fed stimulating foods until their plumage and general health are fully restored. The same action is required when birds in the breeding pens develop raw places that will be pecked at by all of their companions and enlarged sooner or later to a fatal extent.

DISEASES AND PARASITES OF PHEASANTS

Sanitation, or the practice of methods to prevent disease, must ever be the watchword of the pheasant raiser. Besides the general precautions urged in previous pages (p. 3) it should be emphasized that in domestic poultry is found the source of most if not all pheasant diseases, and game breeders can not be too careful in keeping the two groups of birds and their ranges well separated.

Prevention is the more to be striven for, since treatment in so many cases is impracticable. Some bird diseases spread like fire and in a few days may nullify a whole season's preparations and exertions. The treatments of various troubles as worked out by practical pheasant raisers are given below, and further information on the various diseases, their prevention, and treatment may be had by consulting Farmers' Bulletin 1337, on Diseases of Poultry.

Regardless of precautions and remedies there will be some deaths, and effort should be made to remove and burn all dead bodies as promptly as possible. The ground where coops from which birds suffering from parasites or diseases have been removed should be thoroughly limed, any litter burned and the coops disinfected. Sprinkling the ground freely with kerosene and flaming it is another good disinfecting process. As a part of general sanitation also, it is well to remove ailing birds to quarantine, where any trouble they may have will not be communicated to other birds, and where they can be kept under observation and treated.

Sometimes pheasant chicks droop or dwindle, although not apparently suffering from any specific illness. Such a condition is best met by immediate transfer of the brood to a new site, and if necessary by increasing the proportion of animal food in the diet. An outbreak of disease in a rearing field is the signal for immediately abandoning the entire field, which should not be used again until it has been thoroughly renovated.

GAPES

Gapes is the most prevalent and troublesome affliction of young pheasant chicks. As a matter of routine the chicks should be confined to the hatching coop and thoroughly fumigated with a gape remedy every two weeks until they are 8 weeks old. Directions for use accompany commercial preparations for this purpose and should

be strictly followed. The danger of prolonged treatment is asphyxiation, but good results have been observed when the birds treated were reeling and seemed about to succumb to the fumes. If gapes becomes prevalent after the birds are away from the hatching coops, they can be driven into any shed or building that can be closed rather tightly and there fumigated in a body.

DIARRHEA

As a preventive of diarrhea keep the birds in deep vegetation, and once a week to each 12 quarts of drinking water add one-half to two-thirds of a teaspoonful of permanganate of potash. Curds and clabber also are good preventive agents. As a treatment give no water except that treated with permanganate, and if time can be spared administer olive oil to the birds, half a teaspoonful at a time until it comes through clear. Then feed the birds bread and milk, custard, or other soft foods until recovered.

SCALY LEG

The introduction of scaly leg among the birds can be held in check by treating with kerosene the legs and feet of hens kept for brooders, but this should not be done just before or during the time they are incubating the eggs or brooding young pheasants. Every time the young pheasants are trapped for wing-clipping or other reason, dip the feet and bare parts of the legs into kerosene or apply this liquid with a stiff brush. A 5-per-cent solution of carbolic acid is also similarly used to treat scaly leg.

ROUP

Dip into antiseptic solution the heads of birds affected with roup to cure the trouble, and of those unaffected to prevent its spread. Antiseptics suitable for such treatment are: Boric acid, 1 ounce, water, 1 quart; or permanganate of potash, 1 dram, water, 1 pint; or peroxide of hydrogen, 1 ounce, water 3 ounces. Though it seems rather drastic, some breeders advise the use of kerosene as a dip for treating roup. Others report that putting kerosene in water and food has cured troubles similar to roup.

LICE AND MITES

Head or body lice worry sitting hens, sometimes to such an extent as to make them desert their nests. Lice retard the growth of young pheasants and may cause their death. The thorough disinfection of hatching and rearing coops before use and the use of a louse powder on the nest and hen before hatching time have been discussed in previous pages (pp. 26-27). In case a few lice may have escaped these treatments it is well to turn up with a stroke of a hoe a little bare earth near each coop in the rearing field, where the young birds can dust themselves. A little lard applied to the heads of the infested chicks will destroy the mites. The application should be made on a warm, sunny morning, when it will dry quickly.

If the behavior of a sitting hen indicates an infestation of night or spider lice, examine the coop at night, when the mites are more active and can be seen crawling about. If any number are found,

spray the hen and the eggs with a louse killer and remove to a new nest; then burn the old nest and remove the coop for thorough disinfection with a coal-tar dip or spray.

AVIARY, OR FANCY, PHEASANTS

In this country all pheasants, other than the ringneck and its close allies used for stocking coverts, are known as fancy or aviary pheasants. The kinds of pheasants that are regularly dealt in and can be obtained with reasonable certainty in the United States at almost any time are the ring-necked, black-necked, Chinese, Mongolian, golden, silver, Amherst, and Reeves pheasants, and the Manchurian eared pheasant. Others that can be had occasionally are the Swinhoe, Impeyan, Japanese or versicolor, Elliot, Soemmerring, and Formosan pheasants, and the Nepal, black-backed, black-breasted, and lined Kaleege pheasants. Most kinds of pheasants will adopt a polygamous habit, and it is this very quality that fits them so well for hand rearing and restocking purposes. Some few of the rarer species, however, seem to insist on strict pairing, examples, according to present information, being such species as the Kaleege, Tragopan, and Impeyan.

Although the species classed as aviary or fancy pheasants have the reputation of being wilder, more nervous birds, and poorer breeders than the ringneck and its allies, differences in methods of rearing them are necessitated not so much by these characteristics as by the fact that they are reared only in small numbers. If the market justified the attempt, probably several of these species could be handled by the same large-scale methods that are used for the ringneck. Under present conditions of limited market, however, these birds are reared by most breeders only as a side line to the ringnecks. For the sake of economy, therefore, they must be handled with the least additional trouble, and for convenience they are kept separate from the ringnecks and from each other. The different species of pheasants will fight among themselves more than will individuals of any one species, hence must be separately penned. A common rearing field is impracticable, because the hen foster-mothers would persecute stray chicks of a kind obviously distinct from their own brood.

These factors have guided the development of fancy pheasant rearing along lines very different in some respects from those obtaining in the ringneck business. Where aviary pheasants are raised as a side line the breeding pens are usually larger and remain on the same ground the whole season, thus saving labor. This plan works better with these birds than it would with the ringneck, as the fancy pheasants are not so inclined to eliminate every stalk of grass from their pens and then dig up the roots as is the ringneck.

The fancy pheasants also are given more effective protection from the weather in the breeding cages, and on winter range are placed in the most sheltered portion. Usually, however, the birds are in cages or runs of only moderate size the year round. One of these is the breeding cage, while others correspond to the rearing field and to the late summer and winter ranges used for ringnecks.

Fancy pheasants, never intended for liberation, are pinioned by cutting off the last joint of one wing when the young are 3 or 4

days old. This removes the necessity for the periodical clipping of flight feathers, as pinioned birds will never grow primaries on that side and never will be able to fly. Directions for pinioning are given on page 49.

One specialist in rearing fancy pheasants, who has bred no fewer than 16 species, keeps the birds penned at all times. His breeding cages are much like those described under the movable-pen system (pp. 15-17), but stand on the same plot of ground all the season. His hatching coops are placed in similar pens, 12 by 15 by 5 feet in dimensions, the walls and top of 1-inch mesh. The coops and pens are of knockdown construction, so that all parts can be handled by one man and piled flat for transportation or storage. The birds are reared in the same pen where hatched, and this is not moved during the season. The system of spacing and moving illustrated in Figure 10, A, is used, with the difference that the pens are moved only once a year and thus are on the same field four seasons instead of one. This gives plenty of time to renovate by cultivation and crop rotation another area to serve as the next rearing field. Stock not sold is wintered in a breeding or similar type of pen. The feeding methods of this breeder are described as the dry-feeding system (p. 32).

BOBWHITE QUAIL

Though for many years the propagation of the bobwhite¹³ was regarded as difficult or impossible, the combined efforts of a number of game breeders have solved the difficulties one by one until the methods of handling quail are as well developed and as successful as those used for the ring-necked pheasant. The Virginia State game farm, where propagation of this bird has been brought to the highest degree of perfection, is well equipped, and is as methodically operated and efficient in production as any pheasant-rearing establishment. In 1924 more than 2,400, and in 1925, more than 3,000 bobwhites were reared on this farm and distributed to coverts in the State. Production on a still larger scale merely awaits the demand that will justify it. Other species of native quail no doubt can be bred successfully under the same system as the bobwhite, with such minor modifications as climate and locality require.

The equipment and system used in quail propagation are similar in a general way to those long tried in the pheasant industry. Differences are chiefly those necessitated by the smaller size of the birds and their non-polygamous nature, and to a lesser degree by their greater wildness and special dietary requirements. Because instructions relative to pheasant rearing have a general application here, details will not be given except to make clear the important differences in equipment or methods.

BREEDING STOCK

Ordinarily birds trapped in the wild will be most available as foundation stock for the prospective quail breeder, but much better

¹³ "Bobwhite" seems to be the most satisfactory distinctive term for the species called "partridge" in southeastern and "quail" in northeastern States. The term quail, although applied to different birds in Europe, is understood in this country to cover practically all the native gallinaceous game birds smaller than grouse, prairie chickens, and ptarmigans.

results are had from birds raised in captivity. Wild birds may be caught in a variety of types of quail traps, but the simple funnel trap (fig. 19) baited with scratch feed is efficient and inexpensive. Traps of this type should be visited twice daily, if possible, and if only once, that call should be late in the evening, so that there will be little chance of birds being in a trap over night. Otherwise, some predatory enemy is likely to find the trap occupied, wreck it, and probably destroy all the birds. The flight feathers of one wing of captured birds should be clipped, and, dependent on the season, the birds can be placed in a large wintering pen (described later) or arbitrarily paired and domiciled in breeding pens.

BREEDING PENS

In the construction and use of breeding pens for quail there are several departures from the usage in pheasant rearing. The quail

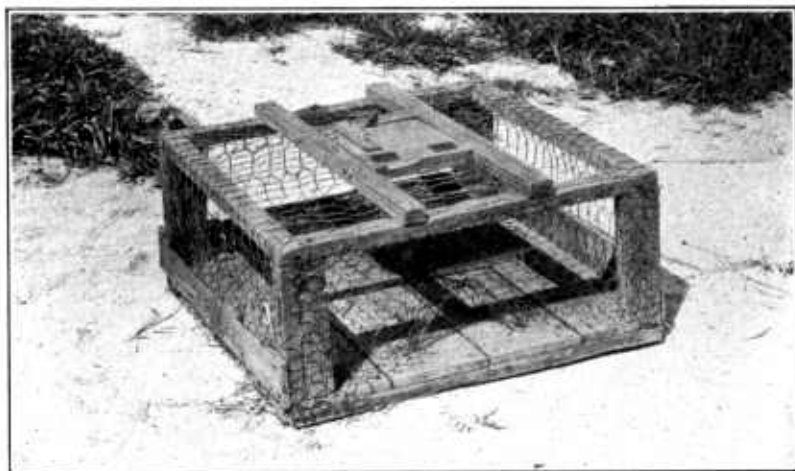


FIG. 19.—Quail trap

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pens (fig. 20) are 5 feet wide, 10 feet long, and 4 feet high. The back half of each is boarded solid and has a waterproof roofing, which keeps the feed trays and dust bath always dry and protects the birds from hot sun or stormy weather. The front half is sided and roofed with hardware cloth, three meshes to the inch. Boards are placed around the bottom of the pen to the height of 16 inches, as the birds are much better contented when they can not see out. A ditch ample to carry off any storm water is dug all around the pen and part or all of the dirt from it is banked against the bottom of the pen to give greater safety from vermin.

The pens should be placed in the sun on well-drained land that has a good natural growth of vegetation or has been seeded to wheat, oats, or any other crop that will furnish green food. In the absence of growing vegetation chopped lettuce can be fed. Small brush piles under which the birds can hide or make the nest should be provided in the cage. The birds are fed and watered through a small door in the back of the pen.

The door in the front of the pen is large enough for a person to get through, but in order to keep the birds as quiet as possible the keeper avoids approaching the front except once each week, when the eggs are collected. When coming to the breeding pens for any reason it is well to give a low whistled signal, which the birds will soon learn. They will then crouch under cover and probably remain quiet while the keeper is renewing food and water or gathering eggs. Sometimes a box shelter is furnished to which they can retreat when alarmed. Without such precaution the birds may easily injure themselves, as their characteristic explosive burst of flight dashes them against the walls of the pen. Some breeders have taken the precaution to drape the entire ceiling of the breeding pen loosely with burlap to protect flying birds from injury.

Once a week with all care and quiet the eggs are gathered with a spoon firmly attached to a long slender stick, one or two of the freshest being left in the nest each time to keep the female striving to

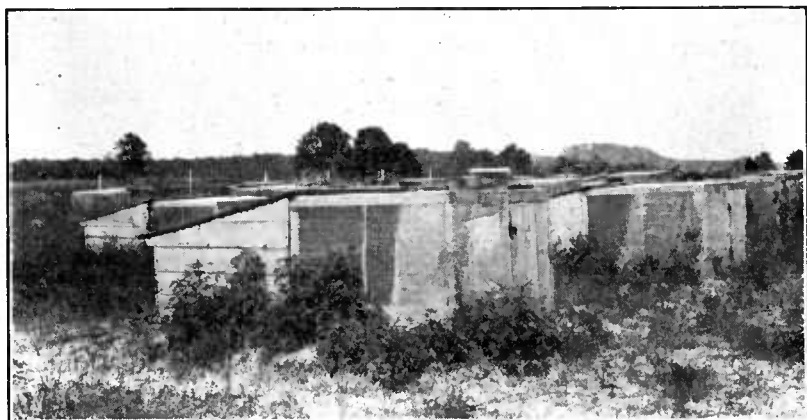


FIG. 20.—Quail breeding pen

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complete a clutch. On the Virginia State farm numerous bobwhite hens have laid 80 or more eggs each in a season and 124 were obtained from one.

HATCHING THE EGGS

Quail eggs are stored and cared for in just the same way as those of pheasants (pp. 25–26). Clean-legged bantam hens are used for incubating and are prepared for their task by dusting with insect powder before being placed on the eggs, and twice thereafter. The third application should be made not less than four days before the hatch is due. The incubation period is 22 to 24 days. The hatching boxes are placed on the ground under low, narrow shelters (fig. 21), and when thus arranged it is not necessary to sprinkle the eggs. In hatching houses the eggs are sprinkled with tepid water two or three times weekly.

Three inches of dirt is put in the bottom of the hatching box to prevent flooding, and over a depression in it a well-formed nest of fine hay is made. Fifteen to eighteen quail eggs, depending on the size of the bantam mother, are put in each nest. The hens are taken

from the nests about 9 a. m. and put in feed boxes (fig. 21), where they are fed and watered, and the eggs allowed to cool for about 15 minutes. As soon as the eggs begin hatching, the nest boxes are darkened (fig. 21, back row) so as to keep the hens as quiet as possible. The hens are left on the nests until about 10 hours after all the eggs have hatched.

BROOD COOPS

When the young quail are all hatched and dried they are transferred with their foster mother to brood coops with small boarded runs attached. (Figs. 22 and 23.) These coops are 20 inches square, 2 feet high in front, and 1 foot at back, with a 5-inch strip of quarter-inch-mesh wire across the front and a number of small holes bored in the sides for ventilation. There is also a ceiling of fine-mesh wire

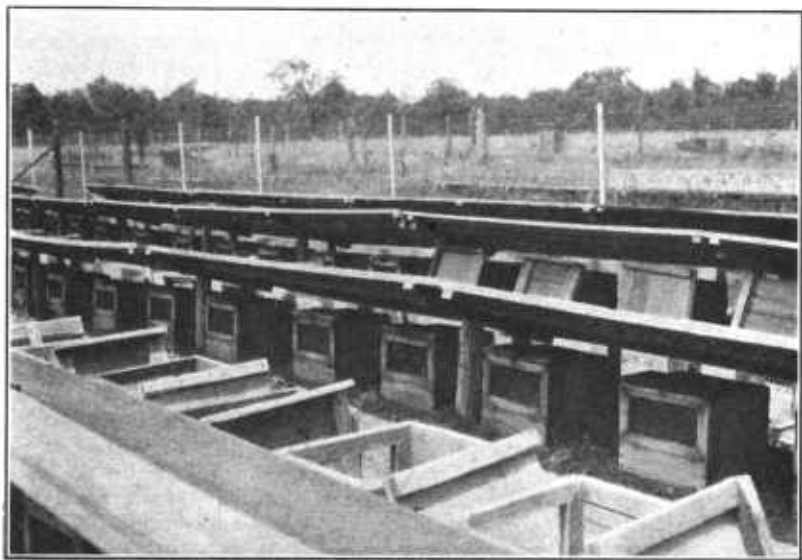


FIG. 21.—Quail hatching boxes

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in the coop 1 foot from the floor. This keeps the bantam from jumping up to the light coming through the ventilator, an action that may result in fatal trampling of the quail chicks.

The coops are floored also to reduce the amount of scratching done by the hen, another cause of death to the tiny quail. The floor is covered with fine hay or other litter before the birds are put in. The coops are hinged at the back and provided with a hook and eye in front so that they are easily opened and cleaned. A small hinged door at the bottom in front will pass the bantam, and a lower slatted entrance with suitable stopper is provided for the quail.

A board run 12 inches high, 20 inches wide, and 6 feet long is fastened flush to the front of the coop. The coop should be placed in rank grass on new or renovated land and be set well into the ground to prevent the escape of any of the young birds. Before the birds are placed in the coops, clean coarse sand is spread all the way across

the run against the front of the coop; this makes a pathway, the upper edge of which is flush with the floor of the coop, and also provides grit for the birds. Baby-chick-size charcoal is scattered in each run. The quail chicks are shut up in the coop with the bantam at night.

REARING PENS

When the birds are 5 days old they are moved to wire pens, a section of which 10 by 30 feet in extent is cut off by a partition fence from an adjoining run 30 by 50 feet in dimensions. The lower part of the netting is of $\frac{1}{2}$ or $\frac{1}{3}$ -inch-mesh hardware cloth extending several inches into the ground and reinforced above the surface with

8 inches or more of boarding. The small-scale breeder can save money by using coarser mesh and lining his pens at the bottom with tar paper. The grass is left long in the larger, but cut short in the smaller pen in which the coop and bantam are placed.

When two weeks old the quail are given range of the larger pen, which they enter through holes at the bottom of the partition fence (fig. 24) small enough to exclude the bantam. Birds reared in these pens at the Virginia State game farm are distributed to

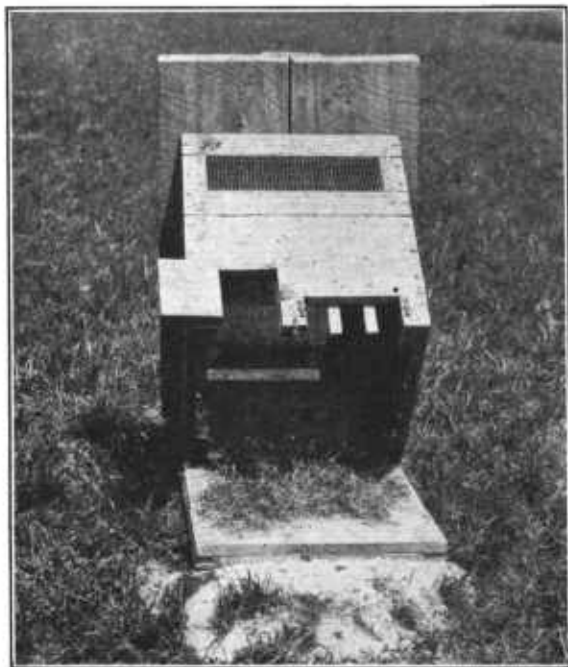


FIG. 22.—Brood coop for quail

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coverts at 6 or 8 weeks of age. When the object is to hold birds to maturity, it probably will be better to adopt the rearing-field system as described for pheasants, and see that the birds are kept well wing-clipped.

FEEDING

On the Virginia State game farm, where quail rearing has been most successful, only clabber from which the cream has been skimmed is fed for the first four days. It is put on a small dressed (and therefore easily cleaned) board, and this is placed close to the coop, so that the bantam can have a share. The first feed is given six or eight hours after the young quail have been transferred to the coop; the number of feedings is four a day. So long as clabber is fed no

water is given. Ripe tomatoes torn open and stuck on nails driven through small boards also are kept before the birds almost from the first.

In the rearing pen, clabber is constantly available to the young birds in small graniteware dishes kept under waterproof shelters. Clabber and millet seed constitute the food up to 2 weeks of age, when fine chick grain, rolled oats rubbed fine between the hands, and millet seed may be given in wooden trays under the waterproof shelter. This is the Coleman system of feeding; others use about the same system described previously in this bulletin (pp. 29-31) for pheasants. Clean coarse sand, and baby-chick-size oyster shell and charcoal should be available to birds in the rearing pen at all times.



FIG. 23.—Quail brood coop with boarded run

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The bantam foster mothers are kept well fed on coarse food too large for the young quail to swallow.

Food for adult quail also is supplied in trays—hoppers no doubt would serve—kept sheltered from the weather. The trays are made with strips extending inward from the top to prevent the birds from scratching out the food. Food that has been found suitable for adults includes chick grain, pheasant meal, scratch feed, kafir corn, small cowpeas, wheat, buckwheat, millet, canary seed, rice, and rolled oats in varying mixtures, and commercial mashes for poultry. Sometimes a little beef scrap is added, especially before and during the laying season. Green food also is then needed. The birds must

not be too fat at this time. Exercise will help to prevent fattening, hence in the winter pen, scatter food in the ground litter so the birds will have to hunt for it. Clabber is kept constantly available to the breeders. In winter, apples, turnips, beets, and cabbages are useful relishes, and in summer, wild berries of any sort and ripe tomatoes are used. Clean coarse sand, charcoal, baby-chick-size oyster shell, and fresh water are constantly available to the birds.

WING CLIPPING

When the young quail are 3 weeks old they begin flying. A few flight feathers on one wing are then clipped from birds that are to be released at 6 or 8 weeks of age. Those to be kept for breeders



FIG. 24.—Rearing pen for quail. Note shade provided in holder for clabber dish (left), and opening through base board (seen to the right of the coop) to larger section of range

should have all the primaries of one wing clipped. In performing this operation avoid cutting pin feathers.

COMMUNITY PENS

Community pens (fig. 25) used for keeping breeders until put in the breeding pens, for wintering the birds, and for holding surplus birds at other seasons, are about 12 by 70 feet in dimensions (on the Virginia State farm; elsewhere larger pens have been used). They are walled and covered with 1-inch mesh wire netting, and the lower edge of the netting is attached to an 8-inch board placed in the ground to exclude vermin. As an additional protection, they are boarded around the bottom to a height of 2 or 3 feet. Both board and brush shelters are provided. The pens should be high enough for men to work in them, or for horses if it is preferred to use these animals in renovating operations.

A sufficient number of these pens should be available for vacating part while the soil in them is broken up and while they are limed and cultivated and new cover crops are grown. To provide green food in spring, oats, wheat, clover, or mixed grasses are sown in fall; late summer cover would have to be provided by spring sowing.

STOCKING COVERTS

Precautions to be taken in stocking coverts are the same as for pheasants (p. 12). Manage so that there is no burst of flight from the shipping container and arrange so that the birds can only creep out slowly, one at a time, find food, and see nothing to alarm them. The person releasing them should retreat quickly after opening the crate. To hold birds on a given area, have it planted in advance with seed producers attractive to birds. For details see pp. 12-13.

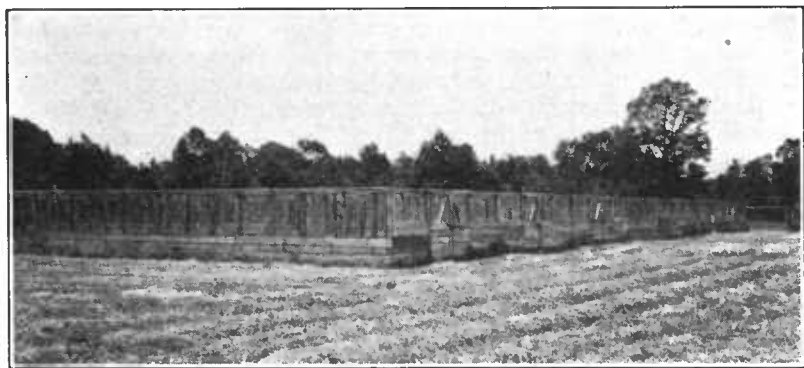


FIG. 25.—Community pens for quail

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QUAIL DISEASE

Much has been written but little is definitely known about a so-called "quail disease." There is no such specific malady, for the same or very similar symptoms have different injurious microorganisms associated with them, and it is usually impossible to say which is causative in occurrence and which secondary. Probably it is better to refer to quail disease as bowel trouble and to state that it is related to symptoms, and doubtless in cause, to the diarrheas and similar illnesses affecting poultry. It is not known to occur among wild quail, and is prevalent in proportion to the closeness, insanitation, and length of confinement.

Prevention is the main hope of avoiding losses through disease. Thorough sanitation at every step, and especially with birds being shipped, is necessary. The value of uncontaminated ground is as great in the case of quail as of pheasants and the methods of assuring it the same.

Mild outbreaks of bowel trouble may be treated by administering a third of a teaspoonful of extract of catechu in each gallon of drinking water. In addition to the catechu, about 15 grains of permanganate of potash may be added to guard against other infec-

tions. Moving the birds to fresh ground and giving them plenty of space are effective steps to take in stamping out disease.

HUNGARIAN PARTRIDGES

Most Hungarian partridges imported to this country are released directly into coverts. The species has been successfully bred on game farms, however, and the business of propagating them may be extended. The Hungarian partridge exemplifies a difficulty to be overcome by the game farmer in the case of birds that will breed only with mates of their own choosing, or in which the sexes are so similar in appearance that arbitrary pairing is impracticable. To obtain natural pairs the following system has been developed:

The community pen in which the flock is kept is provided with small connecting pens, the outlets from which can be closed by a door released by a cord from a convenient blind, where an observer conceals himself as the mating season comes on. Pairs have a tendency to withdraw from the flock, and are likely sooner or later to wander into one of the small pens, and then the door can be dropped. Even then the birds should be watched, for should a third one come to the door seeking entrance to the small pen it is likely to be the mate of one of the penned birds. In such case the door must be lifted and another occasion awaited. When assured that a true pair is isolated from the flock, they can be caught and placed in a breeding cage similar to those recommended for quail.

Rearing equipment and methods may be much like those for quail, but some differences in procedure that have been found advisable are here noted. Cock Hungarian partridges are very devoted to the young, and on a game farm where surplus cocks are available the young are transferred to their care before being liberated on a rearing field or on a beat it is desired to stock. The transfer is accomplished by connecting the coop of the foster mother with another containing a cock partridge, by a board run fitting closely to the ground. The coops should be a few yards apart and gradually the young will go to the cock bird to be hovered. The cock with the young can then be domiciled in a coop in a rearing field or liberated in vermin-free cover as desired.

Feeding may follow, probably with equal success, either the plan recommended for pheasants or that for the bobwhite. One successful American breeder uses hard-boiled eggs and fine oatmeal for the first few days, after that adding partridge meal, and later millet, hemp, and canary seed. Adults prior to and during the breeding season are given millet, hemp, wheat, cut oats, and meat scrap. In winter buckwheat, millet, and wheat are fed.

Where game farming can be carried on in connection with a range stocked with Hungarian partridges, it is the usual practice to take the first clutch of eggs, particularly from nests that seem too exposed or otherwise liable to destruction, and set them under small hens. The female partridge will then lay another set of eggs. Young hatched at about the same time as those of wild birds sometimes are released close to the nests and they are quickly adopted by the wild pair.

NATIVE GROUSE

If grouse trapped wild are used as foundation stock, the chief difficulty arises from their extreme shyness. They should be wing-clipped so that they can not dash against the wire, kept in roomy inclosures with plenty of cover, and accustomed gradually to visits of the keeper by always feeding at the same place and moving cautiously at all times.

Grouse are too valuable to keep in uncovered pens and should be thoroughly protected against vermin. In winter a community pen may be feasible, but in the breeding season each pair of ruffed grouse must be given a separate inclosure. The males are pugnacious among themselves and severe with the hens in mating. Sometimes it is necessary to keep the cock away from the hen except for the short periods actually necessary for fertilization.

It seems necessary to allow the hen to complete a clutch of eggs before they are taken, and then she will sometimes lay another. Unless this happens regularly there would seem to be little advantage in taking the eggs away from the female at all, for grouse are good mothers. However, birds reared by hens will grow up tame, and if successfully held over will provide more manageable breeding stock. By this method eggs obtained from the nest of a wild bird can be used at the start.

The system of rearing can be the same as for quail, but be sure the young birds have plenty of shade; strong sunlight will kill them in a short time. As ruffed grouse grow up, it seems almost necessary that they have more or less of the food they naturally get in woodlands. Their range should furnish browse and buds, and wild fruits and acorns can be supplied from time to time. Grouse of the open country, like the prairie chicken, probably can be raised by the same methods as quail.

WILD TURKEYS

The greatest difficulty in connection with the propagation of wild turkeys is to get birds of the true wild stock. The turkey that is native to the eastern United States, over most of which it originally occurred, has a plumage that gleams like burnished metal; the rump feathers are dark reddish apically and the tail is dark reddish in general and dark brown at the tip. In the domesticated turkey, which is descended chiefly from Mexican stock, the tips of these feathers are whitish and the plumage in general is less metallic. Tame turkeys, however, readily become wild, so that if pedigree is not an important consideration, almost any stock will do, for the birds can be so managed that the progeny will be wild enough for sporting purposes.

The breeding birds, either wing-clipped or pinioned, are kept in a roomy field of the old-pasture type with plenty of natural growth. It is well to have a separate range for young males, as otherwise they will be persecuted by older ones; one adult tom is sufficient for several hens.

The breeding pen is partitioned off from a liberal range of woodland, all under fence. One successful breeder uses a 9-foot fence, of which the lower 5 feet is ordinary farm-stock fence graduating from

small mesh below to larger above and the upper 4 feet of coarse mesh. This is not vermin-proof, and when such a fence is used the vermin must be dealt with otherwise than by exclusion. In the smaller field is a poultry house divided into compartments provided with roosting perches. The upper half of the front of the house is of wire netting, and the lower half of doors that can be closed at night and on stormy days. Usually the birds must be driven in, but feeding them there at times and keeping a dry mash available in hoppers will reduce this difficulty. Brush heaps are scattered over the breeding field, and the hens lay under these.

The eggs are removed daily, leaving one genuine or dummy egg to each nest. They are set under hens in ground nests under the shed. The young are handled like pheasants in a rearing field and are shut in with the hen at night and also by day until the dew has dried off, or in wet weather. Some breeders use female domesticated turkeys for foster mothers. The young are allowed free range with them at from 10 days to 2 weeks of age.

Another plan is to give each female turkey a roomy individual pen, to which the male is admitted when the actions of the birds indicate the proper time, but from which he is excluded at all other times. The smaller pens should have plenty of brush and growing cover and old leaves or other litter on the ground, in which the nests can be formed.

The food for young turkeys may be much the same as that for pheasant chicks, though some breeders have found the use of clabber fully as beneficial in results as it is in the case of quail.

Breeding birds are fed on a mash composed of bran, cut oats, wheat middlings, and corn meal in about equal parts. This is moistened with fresh milk, and after the female has begun to lay, a fresh hen egg, including the shell, is added to the mash for each bird to be fed. Beef scrap also is made available, so that the turkey hen can take what she needs. After the short period allowed for feeding, however, all remainders should be cleaned up.

Adult birds are fed like chickens, except that, in addition, patches of wheat, buckwheat, millet, corn, and the like are sown for them. To allow cultivation and growth of these grains the range of the breeding birds should be partitioned into two approximately equal parts, in either of which the birds can be confined as desired. The planting of grain patches also serves to hold the birds in coverts that are stocked.

WILD DUCKS

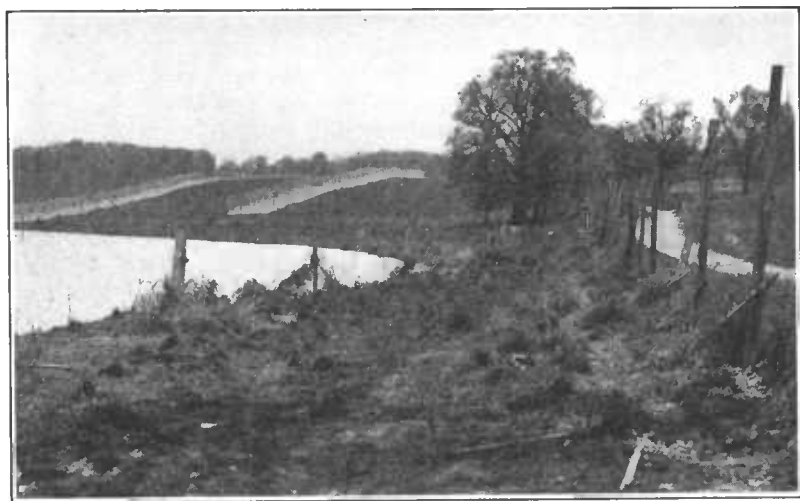
SITE

A lake or pond, preferably not more than 3 acres in extent, fed by running water, is the essential basis of a duck-rearing establishment; a satisfactory one for a few birds can be made by damming a small stream. It is well, if possible, to have twice as much area in marsh as in water; marsh may be artificially established as noted under the directions for planting, page 48. If natural shelter against cold winds is lacking, either a high bank should be built on the proper side, or dense shrubbery, preferably evergreen, planted, or both. To prevent escape of breeding stock and to keep

out natural enemies it is advisable to inclose with woven-wire fence the pond and all adjoining land to be used. Types of fencing are discussed on pages 4-6. The fence should be at a good distance from the water at all points and should be screened with shrubbery or vines to prevent the birds being disturbed by outside occurrences.

WINTER SHELTER

Shelter for the birds in severe winter weather is desirable in most places and essential in the North. Where only occasionally needed it may consist of low, thatched hutches with dry litter on the ground underneath. These should be closed on three sides to keep out snow, and the birds may be trained to use them by having feed scattered inside. Where severe weather is the rule a tight house with plenty of dry litter on the floor should be provided; the birds can be driven in at night and soon trained to resort there.



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FIG. 26.—Duck pond with brush shelters for nests. Pheasant breeding pens in background

Another way to solve the problem is to build a house in the water, the under-water portion of wire cloth of mesh too small for ducks to get their heads through, and the above-water part of frame construction with plenty of south-facing windows to let in the sun. Water seldom freezes in such houses, and the ducks winter perfectly in them. It is best to have one end of these houses extend upon land where dry quarters will be available to the birds when needed. Windows only on the south side are the rule in all duck houses, but ventilation is a necessity except in the severest weather.

NESTING SITES

Tussocks and old logs and stumps in swamps, and marsh, islands, and shore covered with vegetation furnish nesting sites for most ducks. Where there is not sufficient growing cover, heaps of brush, preferably evergreen, can be substituted. (Fig. 26.) Islands are

much frequented by ducks, and if not naturally present, may be artificially provided. The ducks seem to appreciate the security they afford. Even floating but securely anchored platforms covered with earth and coarse litter, as cornstalks, are accepted as nesting sites.

Wood ducks and a few other species that naturally nest in holes in trees will use nest boxes. These may be placed on trees or on posts within a few feet of the ground or water, along shore or on islands. Each should have an inside space measuring about a foot in each direction, with an opening 4 by 4½ inches in one side near the top. The roof should be sloped, projected well beyond the sides, and hinged to permit access to the interior. A cleated walk should be provided leading to the entrance by an easy grade.

PLANTING

Planting is of importance in relation to the vital needs of shelter, nesting sites, and food. Fences may be covered with Japanese honeysuckle, bittersweet, or woodbine, or may be screened with hemlock or arborvitae; the latter plants are excellent also for a wind-break along shore. Marsh valuable for summer shelter and nesting sites can be made by planting cat-tails, but plants producing some duck food should be preferred, as bulrushes and other sedges, wild rice, wild millet, and other grasses. Cover for nests on shore can be furnished by any tall grasses and weeds, but low shrubs are more desirable, as broom and wax myrtle. Trumpet creeper and other vines sprawling over the ground also make good nesting cover.

It is impracticable to stock with food plants a pond constantly frequented by large numbers of ducks. Something can be done, however, with a lake of considerable area. For particulars as to plants adapted to various conditions and methods of propagating them, consult bulletins on wild-duck foods issued by the department.¹⁴ These and a list of dealers in the plants may be obtained by application to the Biological Survey.

Green food or natural roughage is very important on a duck farm, and a good way to supply it is to provide a system of unit ponds; in other words, a canal or broad ditch divided into compartments, in some of which plants can be growing under screen while the ducks are allowed to feed in the others. The best plants for such ponds are water-cress, waterweed, coontail, duckweeds, and muskgrass (described in Department Bulletin 205).

BREEDING STOCK

The wild duck most easily handled and therefore the most frequently kept on duck farms is the mallard. Wild stock of the closely related black duck is more high-strung and shy, needs more space, and does not do well if disturbed. After the first generation raised in captivity, however, the black duck does as well as the mallard. The wood duck is not especially difficult to handle, except that the young ducklings are sometimes slow to start feeding

¹⁴ Eleven Important Wild-duck Foods (Department Bulletin No. 205) and Propagation of Wild-duck Foods (Department Bulletin No. 465).

and are great climbers, and on these accounts need special treatment. This species requires nest boxes, described in a previous paragraph on Nesting Sites (p. 48).

The production of fertile eggs is the basis of success in breeding any game bird, and difficulty in this respect has been the greatest obstacle to success with all but a few species of wild fowl. Success with species usually slow to breed seems to depend on keeping birds, if of wild stock, long enough for them to become reconciled to their loss of freedom, and whether of wild or propagated stock, on giving the birds ample space for them to pair naturally and find suitable cover for their nests, and on allowing the necessary degree of isolation in a sufficiently natural environment.

Breeding stock of whatever species should be obtained in fall, so that it may be settled in its quarters before the breeding season, which comes rather early in spring. Even if they do not then breed, the owner should not be unduly disappointed but should remember that not all birds will breed during the first years of life or of captivity.

Birds received after a long trip should not be allowed to visit the pond, as their plumage will not be oiled and in good order and they will get water soaked. If feathers of newly arrived ducks seem to be dirty, give the birds a pan of tepid water on a sunshiny morning; when they have again gotten their plumage in good order they may be liberated to visit the water. Feed the birds with especially nourishing food until they recover from the hardships of travel.

PINIONING AND WING CLIPPING

Stock purchased from dealers will arrive either pinioned or wing-clipped, and it is necessary to perform one or the other of these operations on all birds intended to be kept as breeding stock. Wing clipping simply means shearing off the principal flight feathers, or primaries, and it is necessary to repeat the operation at least annually after the regular molt in midsummer. Pinioning means cutting off the last section (the fingers) of the wing to which the long flight feathers are attached.

To pinion an adult bird, raise the thumb of the wing (at base of last joint) and tie a cord tightly around the last joint well up under the thumb. (Fig. 27.) Have ready some tannic acid in powdered form. With a pair of sharp scissors clip off the joint close below the cord, removing all or nearly all of the long flight feathers or primary quills. At once take a pinch of tannic acid and press it firmly into the wound to check bleeding. Glycerite of tannic acid (liquid tannic acid, 1 part, glycerine, 4 parts) also is used for the purpose. This seals the wound and gives good results. The cord should be removed a few days later when the wound is healing.

Pinioning ducklings is very simple. Operate when the birds are 4 to 7 days old, if in good condition, snipping off the last joint and dipping the stump into tannic acid. Bear in mind that a pinioned bird never can fly; so if flight is likely to be desired at any time, it is better to continue the clipping of flight feathers.

FEEDING ADULTS

The staple food for adult wild ducks on game farms is whole oats and mixed small grains, as wheat, barley, buckwheat, scratch feeds, and mill wastes. A mixture of weed seeds and broken rice, which can be obtained from rice mills, has been used with satisfactory results, and waste from other types of mills no doubt will serve. Little corn is fed, as a rule, and that chiefly in winter. When the weather permits, scatter the food in water, as this gives the birds their natural feeding conditions and leaves no food where it is likely

to attract rats. With proper feeding, however, little or no food should be left over.

The ducks are fed twice a day, morning and evening. Forcing foods are universally used for some time before and during the breeding season; the same rich foods also are often used in winter and in special cases for birds weakened by exposure or other cause. The special rich foods are given in the form of a scalded mash, the bulk of which may consist of alfalfa meal, ground corn or oats, with a liberal addition of beef or fish scrap. Feed the mashes only crumbly

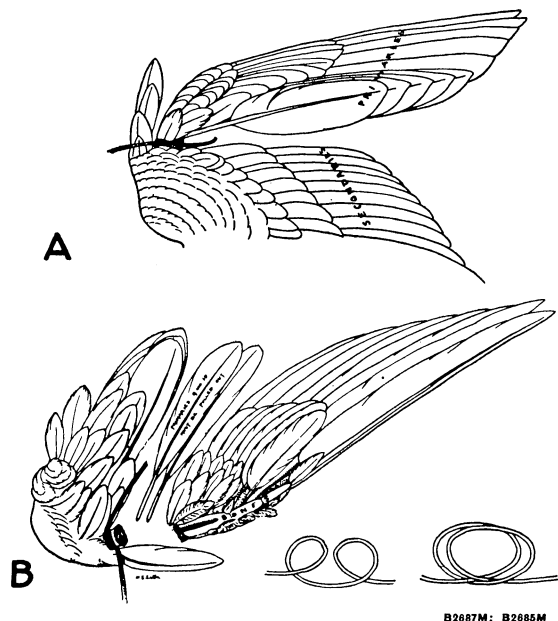


FIG. 27.—Method of pinioning. A, Upper side of wing showing flight feathers separated from secondaries, and tied just within point of amputation; B, Underside showing place of amputation and form of knot used

moist and no more in quantity than the birds will consume at once. The same mixture dry, however, may be kept available to the birds throughout the breeding season, putting it in a trough or hopper sheltered from rain. Good results have been obtained also by using chopped fresh fish or live minnows as a forcing food.

Roughage is desirable at all times, the best being aquatic plants, which may be grown in sufficient quantities in the pond most frequented by the birds if it is large enough; otherwise the system of unit ponds mentioned under planting (p. 48) may be used. Aquatic plants also may be gathered from any convenient source and thrown into the feeding pond. In the total absence of such plants, chopped-up grass, weeds, lettuce, or beets may be used. Plenty of coarse, sharp grit should always be accessible to the birds, and it is well also to keep before them a mixture of ground-up oyster shells and charcoal.

CARE OF EGGS

Eggs are sometimes purchased when duck breeding is started, but they do not always bear shipment well. The best results are obtained from hatching the eggs of a well-acclimated stock of adult breeding birds. Wild ducks lay early, and it is necessary to be prepared to care for the eggs in March and April. When the eggs are collected regularly, mallards will lay from 25 to 40 eggs each breeding season. In the case of other species, take the first setting of eggs and let the duck incubate any further eggs that are laid. If taken perfectly fresh, the eggs may be kept one or two weeks. Handle them carefully. Set them on end in bran in a cool place and turn daily. Eggs are usually set under small hens or bantams, 12 eggs to the setting for the larger hens, and 8 eggs for bantams.

Setting boxes may be built in tiers and a great many put in a small space. Make the bottom of the nest of turf, hollowed out by scraping off some of the dirt underneath the middle, and thoroughly moistened. See that the setting boxes are free from vermin; spraying or painting them with preparations containing carbolic acid or creosote will accomplish this.

Prepare the hen by dusting her feathers well with pyrethrum powder, repeated if lice appear. Test the hen's intention to incubate by keeping her on china eggs two days. Food, water, and exercise are given the brooding hens once a day, mornings preferred. Fouled nests should be cleaned at once and broken eggs removed; wash in tepid water any eggs fouled by the contents of a broken one, and make a new nest of turf. Duck eggs require considerable moisture, and the turf helps in this respect; the eggs should also be sprinkled daily with tepid water. Hatching coops on the ground, as described for pheasant rearing (p. 17), also can be used and will prove beneficial in relation to moisture for the eggs.

When incubators are to be used larger numbers of eggs should be accumulated. The incubator should be run at a temperature of 103° F. and carried to 104° F. during hatching. The eggs should be turned, aired, and sprinkled with tepid water daily, and the air in the incubator should be kept moist by the evaporation of a never-failing water supply. Incubators are sometimes used to hatch eggs incubated under hens to prevent loss of ducklings by trampling.

Eggs of mallards hatch in 27 or 28 days, those of black ducks in 26 or 27, and those of wood ducks in 28 to 30 days.

CARE OF YOUNG

Young hatched in incubators, as soon as dry, should be put under broody hens that they may learn to nestle before being placed on the rearing field. When young are hatching under a hen, disturb as little as possible, but remove eggshells with care.

Small coops with bottomless runs attached are used to house the hens and broods. Half-inch wire mesh is necessary to confine small ducklings, which must not be allowed to run in wet grass and get chilled. The runs should be covered also with wire netting and either set in partial shade or provided with screen (small homemade tables

are good) against the strong, direct rays of the sun, exposure to which will quickly kill the young birds. Runs should be shifted frequently to fresh ground.

After the ducklings are a week old they may have larger runs, 8 feet square or more, which should be shifted at least once a week. As an alternative, the use of small coops may be continued, set inside a larger fenced yard, and the ducklings allowed free range of the place. By this time they will have learned the hen's call and will return to her for brooding and for the night.

Contrary to popular impression, ducklings when brooded by hens do best if kept away from water until their bodies are well feathered, about 8 weeks old. When brooded by ducks their plumage is kept oiled, and wetting does not hurt them. At earlier stages whenever their plumage begins to be fouled let them bathe in shallow pans of tepid water for a short time on warm, bright mornings.

In the larger inclosure just described they may be given water, also feed, in troughs 3 inches deep, 6 inches wide, and 8 to 10 feet long. Wood ducks and all deep-water ducks seem to do better if allowed freer access to water and probably will do best with ducks as foster parents. For those reared with hens water may be furnished safely in a good-sized baking pan lined with green turf that is then barely covered with water. This prevents the ducklings from getting their backs wet and gives them employment probing mud and nibbling grass. When such ducklings are large enough to be given access to deeper water, they should not be allowed to stay in it very long at first, and at no time to remain in it during cold weather or at night and get chilled. A commodious pen with a corner extending into a pond is suitable for this stage of duckling growth, or the hatching coop and foster mother can be installed with the brood near the shallow edge of a pond.

At 8 weeks of age all ducklings can be allowed to run together, a warm morning being chosen for their introduction to the pond where they are to mature. For the first few days they should not be allowed to stay in too long, but should be driven into the dry compartment of an inclosure consisting of a wire cage in the water and a shed on shore. This should be their permanent feeding and roosting place, where they can be penned whenever wanted.

FEEDING DUCKLINGS

Fine grit, mixed with a little ground charcoal, should be before ducklings from the very first, as well as water in drinking fonts in which they can dip only their bills. The first feeding, when they are a day old, may be finely ground hard-boiled egg mixed with cracker crumbs or rolled oats, and a little sand, the mixture being no more than crumbly moist. The foster mother should be fed with grain to prevent her taking all the ducklings' food. For the same reason, as soon as the ducklings have learned to eat, it is better to feed them outside the coop.

Feeding at first should be in small quantities and as often as five times a day. In a few days the meals can be cut down to four and later to three. After the first day a good feed is 3 parts oatmeal and

1 part commercial duck meal, scalded and fed only crumbly moist. Sprinkle in this mixture somewhat less than a tenth its bulk of coarse sharp sand and about a quarter by bulk of hard-boiled eggs, ground shell and all.

After one week the base of the food may be varied with barley meal, bran, and middlings. Continue this a week, then gradually reduce the egg until at three weeks none is given. At this time add good beef scrap until it forms 10 to 15 per cent of the food, and begin giving in the mash small mixed grains, which can be increased in quantity and size as the ducklings grow. Little corn is given until the birds are practically grown. Abundant chopped green food, as grass, lettuce, and rape should be given from the first; nothing is better for the purpose than water plants, especially duckweeds.

PRECAUTIONS AGAINST DISEASE

Never place young ducks where there is not plenty of shade. Adults also need shade, but they are not so susceptible to harm from the sun's rays as are ducklings.

Do not overcrowd.

See to it that young and old always have a perfectly dry place both for sleeping and for retreat in the daytime.

Remove all food not eaten by ducklings and do not expose their drinking water to the sun.

Segregate sick birds at once and burn the bodies of all birds that die of disease. Spade and quicklime the pen in which they have been confined.

WILD GEESE

Thus far real success in propagating wild geese has been had only with the Canada goose, and the following remarks apply particularly to that species:

RANGE

Geese need room, and the ideal range should include a pond or a section of lake or sound shore, together with ample pasturage and some shade. Shelters other than natural cover are not required. Pinioned birds (and the primary stock of most breeders will be pinioned) need protection, especially from dogs. A dog-proof fence is needed about the breeding area at least, and if the goslings are to be protected from small vermin the lower 2 feet of the fence should consist of 1-inch-mesh wire netting or of boards, in either case with an overhang at the top of this section.

BREEDING STOCK

Propagated geese are more desirable as breeders than birds captured in the wild, for the latter may not mate and settle down to breeding for several years, whereas reared birds sometimes breed when 1 year old. Geese must be allowed to select their own mates. They remain mated for life, and it is advisable to handle them in mated pairs and not attempt to break or mix pairs. These birds

live to a considerable age (50 years or more) and are better breeders in late than in early life. It is well to have room enough for the pairs to be well separated, and other birds on the farm, especially young, should be kept away from the geese, which may attack them.

NESTING

Geese are somewhat temperamental about their first nest and should be left entirely undisturbed when mating and selecting their first nesting site. In succeeding years they more boldly select and hold their chosen home, resorting when possible to the site of former years. If the range has tussocks of grass, no nesting material need be furnished; in their absence it is advisable to supply hay or straw. Nesting takes place early in spring and the number of eggs varies from 4 to 7, the usual number being 5. The female sits very close, and the gander zealously guards the nesting site. At this time the birds must be fed and watered near the nest. Intensive breeding methods also have been successfully tried with Canada geese, two and three clutches of eggs being obtained from each pair. The extra eggs are hatched under hens.

CARE OF YOUNG

If on good pasture, where they can get all the green food they want, the goslings require little care other than by their parents. It has been found best to prevent them from getting into water until they are about 10 days old. During this period drinking water should be supplied in fountains in which they can dip their bills only. The water should be renewed frequently and kept in the shade. Shade is necessary also for protection of the goslings from heat.

FOOD

Geese are primarily grazers and can live indefinitely on pasture that will support cattle. Rye furnishes good winter pasture, and millet or mixed grasses satisfactory summer range. Before and during the breeding season, it is advisable to feed grain. Almost any kind will be eaten, but a mixture of 75 per cent whole oats and 25 per cent corn is recommended before egg laying, and just the reverse of these proportions during the incubation period. Oats and a little corn are fed regularly in winter, especially when pasturage is not available, and at this season cabbage, apples, turnips, and the like can take the place of green feed. Ground hay or alfalfa also are good.

Goslings as well as the adults can subsist wholly upon green food, but some breeders advise feeding them stale bread moistened with milk. This is laid on board where it will dry up rather than sour, if not eaten. When the young are 10 days old and browsing actively, a supplementary ration of soaked oats, cracked corn, or scratch feed may be given. When they are growing their feathers, feed whole wheat. Keep a plentiful supply of ground oyster shells and clean gravel always available.

PINIONING

In localities where geese can easily glean a living in winter it has been found that propagated birds will remain about their home, even if not pinioned. In most cases, however, it will no doubt prove desirable to render the birds incapable of flight. Directions for pinioning are given on page 49. (Fig. 27.) Family loyalty is so strong among geese, however, that usually all will remain if only one or two of each family are incapable of flight.

SWANS

Although swans are classed as migratory game birds, there is no open season on them anywhere in the United States. One of our two native species, the trumpeter swan, is so rare that no permits are issued for trapping any swans in the region—British Columbia, Alberta, and Montana—where small flocks of trumpeters are still known to exist.

STOCK

Breeding stock of several species of swans may be obtained from dealers, a list of whom will be furnished upon request addressed to the Biological Survey. Swans are slow to mate and remain mated permanently. The only satisfactory way to buy them, therefore, is in guaranteed mated pairs. Under normal circumstances never separate the birds of a pair. It is necessary to pinion swans, as the birds are not sure to return home if allowed to fly. Directions for pinioning are given on page 49. (Fig. 27.)

RANGE

Swans are large and aggressive birds and must be given plenty of space. If the available range is not large enough for the pairs to separate when they choose, thus preventing constant fighting, an ample pen should be wired off for each pair. The birds can not keep in good condition without access to water, and if a body of water is available large enough to maintain plant growth for natural roughage, so much the better.

FEEDING

Swans graze, but not so extensively as do geese. Grass, clover, and especially alfalfa are suitable green foods, and it helps a great deal if a growth of water plants is available to the birds. If not directly accessible, some of these plants should be gathered occasionally and fed, or such plants as kale and spinach can be substituted. Water weeds are a very necessary element of food for the cygnets, or young. In addition to roughage, swans must have grain, and this is usually thrown in the water for them; any small grains will serve. Grain given to cygnets should be soaked over night; but oatmeal is preferable for them. In winter, clover and alfalfa hay, chopped roots, bran, oats, and a little whole corn may be fed. Bread and root vegetables cut in sizes convenient for swallowing also are some-

times given to them. Plenty of grit and clean water should always be available. Swans are slow feeders and should be fed apart from ducks, geese, or chickens. If this is not feasible, place their food in a pail on a box and wet it thoroughly.

BREEDING

Swans, like wild geese, are allowed entire charge of family affairs. They pair very deliberately, but for life. They are particular about nesting sites and are said to take most readily to small islands. If natural conditions do not permit thorough separation of the pairs, fences must be used. Adults not only fight among themselves, but will kill the young of other pairs.

WINTERING

Swans can winter in the Northern States in a shelter open to the south and littered with plenty of hay or straw to protect their feet. Where their swimming pool does not freeze over, no winter shelter is required.

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February 18, 1927

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